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INTRODUCTION

Information Technologies and Internet as a part of Computer science creates new approaches and perspectives, new models and numerous services, which opens up and makes use of the world of information and symbolized knowledge. Advances in Information technology, including the Internet, have dramatically changed the way we collect and use public, business and personal information.

The 2nd **International Conference on Applied Internet and Information Technologies** is an international refereed conference dedicated to the advancement of the theory and practical implementation of both knowledge of Information Technologies and Internet and knowledge of the special area of their application.

The objectives of the **International conference on Applied Internet and Information Technologies** are aligned with the goal of regional economic development. The conference focus is to facilitate implementation of Internet and Information Technologies in all areas of human activities. The conference provides forum for discussion and exchange of experiences between people from government, state agencies, universities and research institutions, and practitioners from industry.

The key Conference topic covers a broad range of different related issues from a technical and methodological point of view, and deals with the analysis, the design and realization of information systems as well as their adjustment to the respective operating conditions. This includes software, its creation and applications, organizational structures and hardware, different system security aspects to protocol and application specific problems. The Conference Topics are:

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President of the Organizing Committee
Ph.D Borislav Odadžić

Zrenjanin, October 2013

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CONTENT:

Tag-Based Collaborative Filtering in e-Learning System

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Abstract - The goal of this paper is to propose a system for giving recommendation in e-learning by using tagging technique and collaborative filtering. We plan to use PHP programming language for developing the system, and mysql database for storing information about users, learning items, tag lists and etc. Proposed system proposes and student grouping in virtual learning group, based on their knowledge and interests. Also, students can post tags for the learning materials. Collaborative filtering is using to present more relevant information to students based on how other students from the same virtual group have acted. In that content, tags posted from the students are very useful for the system to figure out which learning materials should be adequate for other students from the same virtual group.

Starting point of this paper is that students with similar interests might post similar tags and similar resources might have similar tags, especially when they belong to the same virtual group. Students participating in virtual groups will produce more precise suggestion recommendation for the students, based on tags on other students that belong to the same virtual group.

I. INTRODUCTION

Nowadays, e-learning systems contains huge amount of learning items and information from different learning area and subjects. That's why searching and browsing for relevant, useful and interesting information is quite difficult and often ineffective. It takes more time and student can't find the most adequate content. On the other hand, students come from different knowledge backgrounds and have different learning styles and preferences. To effectively meet these diversities, an e-learning system should be able to offer different learning experiences to different students. In that manner, the main goal of every intelligent e-learning system is to deliver the most useful learning material to the students, in format that is adequate to student learning style. It means that e-learning platform should be assembled from two important modules: selection of the most relevant learning content to students and to detect the most adequate learning style.

The most acceptable format can be detected by using some algorithm for learning style detection (VARK, David Kolb's model, Peter Honey and Alan Mumford's model, etc).

There are several possible solutions and algorithms for selection the most relevant learning content. This paper proposes using tagging technique and collaborative filtering to select the most adequate content to the students.

Tagging represents an action of reflection, where the tagger sums up a series of thoughts into one or more summary tags, each of which stands on its own to describe some aspect of the resource based on the tagger's experiences and beliefs [1].

Marking content with descriptive terms, also called keywords or tags, is a common way of organizing content for future navigation, filtering or search. Though organizing electronic content this way is not new, a collaborative form of this process, which has been given the name "tagging" by its proponents, is gaining popularity on the web [2]

II. COLLABORATIVE FILTERING

Recommender systems aim at predicting items or ratings of items that the users are interested in. Collaborative Filtering algorithms are the dominant techniques applied in recommender system algorithms. To improve recommendation quality, metadata such as content information of items has typically been used as additional knowledge [3].

Collaborative filtering is a technology utilized primarily to predict individuals' preferences. The concept of collaborative filtering has its origin in information filtering, which guides a reader's choice by filtering a large amount of information and obtaining preferences collaboratively based on preferences shared by like readers [4]. In general, it is the process of filtering for information using techniques involving collaboration among multiple data sources. It is a traditional and wildly used approach to recommend items to users based on the assumption that similar minded people may have similar taste or behaviors. In general, there are two kinds of collaborative filtering methods: user-based and item-based [5]. So far, collaborative filtering is the most successful technique in the design of recommender systems [6],

where a user will be recommended items that people with similar tastes and preferences liked in the past.

The similarity between pairs of items can be scored by using the Pearson correlation coefficient. It gives values to how reliably users' scores change together.

A commonly used collaborative filtering approach is based on the intuition that the best recommendation consists of tags attached to the resource by people similar to the user [7].

Traditional collaborative filtering systems have two steps. The first step is to look for users who share the same rating patterns with the active user whom the prediction is for. Then, the systems will use the ratings from those like-minded users found in the first step to calculate a prediction for the active user. Traditional collaborative filtering systems have two steps. The first step is to look for users who share the same rating patterns with the active user whom the prediction is for. Then, the systems will use the ratings from those like-minded users found in the first step to calculate a prediction for the active user [8].

III. TAGGING

With the increasing popularity of the collaborative tagging systems, tags could be interesting and useful information to enhance recommender systems algorithms. Unlike attributes which are "global" descriptions of items, tags are "local" descriptions of items given by the users [3]. Tagging represents an action of reflection, where the tagger sums up a series of thoughts into one or more summary tags, each of which stands on its own to describe some aspect of the resource based on the tagger's experiences and beliefs [1].

A tag can be defined as term or keyword assigned to some information (word, sentence, whole article, etc.). Tags help for describing an item and make items for visible and easy for finding. They are comments from users, comment or notes from authors of item. The tagging information implies user's important personal interests and preferences information, which can be used to recommend personalized items to users [5].

A tagging system allows users to create arbitrary tags that are not part from the content but are good enough to give some good suggestion for the content. Therefore, those user-defined tags can reflect user behaviors and preferences with which users can easily make acquaintance, collaborate and eventually form communities with others who have similar interests [9].

In e-learning, tagging can be defined as a way for aggregating information for articles available in e-learning systems.

Tagging is very useful for users to figure out other users with similar interests within a given category. Users with similar interests might post similar tags and similar resources might have similar tags posted to them.

Tagging allows ranking and data organization to directly utilize inputs from end users, enabling machine processing of Web content [10] and it is a process by which users assign notes and labels to some learning content, to share and suggest that to other users.

On the another hand, tagging bridges some gap between browsing and search, because browsing enumerates all objects and finds the desirable one by exerting the recognition aspect of human brain, whereas search uses association and dives directly to the interested objects, and thus is mentally less obnoxious [11].

Recommending tags can serve various purposes, such as: increasing the chances of getting a resource annotated (or tagged) and reminding a user what a resource is about. Furthermore, lazy annotating users would not need to come up with a tag themselves but just select the ones readily available in the recommendation list ac-cording to what they think is more suitable for the given resource [12].

In this situation recommending tags assigned to a resource by similar users (collaborative filtering) should give similar results as recommending the tags frequently attached to the resource by any user.

IV. PROPOSED SYSTEM

The goal of this paper is to propose a tag-based collaborative system for e-learning. We plan to use PHP programming language for developing the system, and mysql database for storing information about users, learning items, tag lists and etc.

It's known that collaborative tagging systems are usually composed of users, resources and tags and allow users to assign tags to resources [12]. In that manner, in the proposed system, users are going to be students and teachers, resources are learning items that are posted to the learning system from the teachers.

The proposed system is going to has two types of users: students and teachers. Teachers upload new learning items and add tags for the items. Students can read the learning items and add tags. Each student belongs to some virtual group, based on their interest. It means that students need to select the learning area. That step will initiate update of student profile – will set his interest and set virtual group for the student.
To upload new learning materials, the teachers need to select adequate subject for the learning materials and to add one or several tags. In the proposed system, tags contains following parameters:

- Learning item unique number
- Virtual Learning Group
- The order in the list

These parameters are important in the process of retrieval the most adequate tags for learning contents.

While adding new learning material, she system will propose several tags that can be accepted or not from the teacher. Of course, teacher can add new tags that are not on the suggest list.

Tags will be suggested based on:

- Tags selected by learning title and learning content
- The most used tags

The title and abstract from the learning article are divided into words, which are then cleaned of non-alphabetical, conjunctions, contributions, non-numerical characters and etc. Then, the system assigns a score to each word, which represents the probability of being chosen as a tag – number of times being chosen as a tag divided by the number of occurrences. For instance, if the word occurred in the titles of previously entered resources less than 10 times its probability of being a correct tag is set to 0.01 which is an empirically estimated value for low-frequency tags [7]. The tags with the highest score will be proposed to the teacher.

Except tag score parameter, system will check and for the most use tags in other learning items from the same virtual group. It means that the system will execute a query to select the most use tags, limit up to 10. As a result, system will propose list with maximum 10 tags to the teacher. At first, system will find the most adequate content that is already in the system based on item title. Then, will get the added tags for selected items, order them by number of using and will generate tag list.

Proposed tag suggestion algorithm favors tags that have high rating - are used by a huge number of users. Second, it honors the high correlation among tags, e.g., if tags php and phpmyadmin tend to be used together by most users for a given object, they should co-occur in our suggested tags.

Except select tags from the lists, users can add their new tags. To be more effective, the system will use synonym list for the tags. It means that system have to check in the synonyms list and make relation between tagged learning item, the tag and the synonyms.

Uploaded learning items are available for registered students in the same virtual group. While reading learning items, they can add new tags for selected learning content. After they add new tag, the learning item owner (the teacher) will get notification about new tag for his learning material. Then, it can accept or reject the tags.

Other aspect of the system is recommendation the most adequate content to students, based on virtual group where they belong.

At first, student needs to select some learning item. At the same moment, the system will get the tag list for that learning item and make selection for other items, based on comparing the tag list of opened learning item and other learning items from the same virtual learning group. Based on tag similarity on learning items, calculated with Pearson correlation coefficient, system is going to propose new learning items, which are similar with opened one.

Each tag has own rating. If the value for X increase as Y increases, so a user that rates X highly also rates Y highly, even if they don't increase at the same rate, the score will be high towards 1. If one consistently decreases as the other increases the score will be negative, towards -1, and if there's no relationship it will be zero.

In the proposed system, we suggest using following PHP code for suggesting similar learning items:

```
$learning_items = array(
    'learning_item_1' => array(1,3,4,6),
    'learning_item_2' => array(2,3,4),
    'learning_item_3' => array(1,3,5,7),
    'learning_item_4' => array(1,2,3,4,5),
    'learning_item_5' => array(1,3,6,7)
);


function calculate_simillarities($learning_items) {
    $similarities_array = array();

    foreach($learning_items as $item => $scores) {
        $similarities_array[$item] = array();

        foreach($learning_items as $item2 => $scores2) {
            if($item2 == $item ||
isset($similarities_array[$item][$item2])) {
                continue;
            }

            $sim = calculate_pearson_coefficient($scores, $scores2);
            if($sim > 0) {
                $similarities_array[$item][$item2] = $sim;
                $similarities_array[$item2][$item] = $sim;
            }
        }
        arsort($similarities_array[$item]);
    }
    return $similarities_array;
}
```

In the code above, calculate_pearson_coefficient() is function for calculation of Pearson correlation coefficient from two list, passed as parameters. The coefficient is value will be between -1 and 1.

V. CONCLUSION

In this paper we proposed a system for giving recommendation for tag list and recommendation for useful learning item, in e-learning system by using tagging technique and collaborative filtering. Recommendation of tag list is useful while teachers adding new learning items. So, they can choose some of suggested tags or insert new tags.

On the other hand, students belong to virtual learning groups, based on the subject they selected. It means that students in the same virtual learning group require similar learning items. They are not just viewers, they also can add tags for the learning items.

Each learning item has own tag list (tags added by teachers and students). Based on tag similarity on learning items, calculated with Pearson correlation coefficient, system is going to propose new learning items, which are similar with opened one.

It's known that there are a huge number of recommendation techniques, but collaborative filtering recommendation is one of the most successful recommendation techniques. To be more effective process of recommendation, good idea is using combination of tagging and collaborative filtering. It means that by using

tags, users post their experience or opinion about some learning content from the e-learning system. Then, the system will make recommendation based on user's model similarity and their participating in the same virtual learning group.

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