Recommendation in Adaptive Learning System

Viktória LOVASOVÁ*

Slovak University of Technology in Bratislava
Faculty of Informatics and Information Technologies
Ilkovičova 2, 842 16 Bratislava, Slovakia
viktoria.lovasova@gmail.com

Recommender systems provide the user with recommended items he might prefer, or predict how much he might prefer each item. These systems help users to decide on appropriate items, and ease the task of finding preferred items in the collection [1].

It is very common nowadays, that students learn via adaptive web based learning systems. Every user learns with a different speed, that is why it is appropriate to estimate a user's knowledge and recommend him the most useful learning object (LO). In modern browsers, the user can view different web pages in multiple windows or tabs, so he can focus on one page and switch between others. If we could capture such behaviour with the use of parallel browsing while he is learning, we could improve recommendations.

We propose and implement a recommendation system in ALEF based on users' parallel web browsing behaviour with the aim to improve recommendations. ALEF is an adaptive learning education system [2] being developed at FIIT that is used in several courses. We track user's behaviour in ALEF via client-side scripts. We cannot know what sites other than ALEF ones are opened by the user, because the script scope is only within the system being tracked. Because we recommend only learning objects from ALEF, this is not a severe limitation. We consider these actions important for our research: page *load*, page *unload*, *time spent* on the page, *switching* between tabs.

According to such browsing behaviour, one learning object could rate another one using the user's tab switches between them. We proposed the following formula where $R_{i,j}$ is the rating for LO_i from LO_j, v is a value which is added according to the time spent on the tab after the switch in seconds: $R_{i,j} = R_{i,j} + v$. Let LO_1 and LO_2 be learning objects in ALEF and suppose that the user switches from one tab with LO_1 to other tab with LO_2, he spends there 2 minutes, and then he switches back to LO_1 (Figure 1). From these actions, we can assume that there is a relation between LO_1 and LO_2, since the user spent some time on LO_2. When another user visits LO_1, we can recommend him the LO_2.

We evaluate the content-based similarity between the objects rated by user switch pairs by computing their cosine similarity on the concepts assigned to them in the

* Supervisor: Martin Labaj, Institute of Informatics and Software Engineering

Spring 2014 PeWe Workshop, March 21, 2014, pp. 105–106.

domain model. If the switch pairs correlate with the content similarity, the algorithm could replace content analysis in domains, where it is costly – e.g. video or image domain.

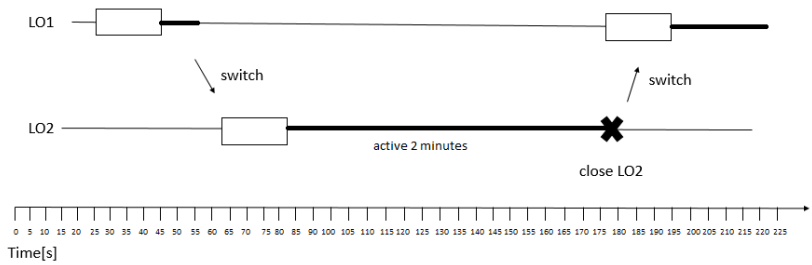

Figure 1: Switching from LO_1 to LO_2

If the correlation is not observed, it can mean that the user browsing behaviour express different relations than those stemming from content. In that case, we will prepare a dataset by selecting pairs rated high according to browsing behaviour (our method) together with those rated by content similarity, and, as a control, we mix in low-rated and random pairs. An expert on the course will evaluate the pairs to identify relations.

We aim for realizing the method in the live system for use in the FLP course within ALEF where students prepare for seminars and exams over longer time periods. They will have a widget on the right side, where there will be recommendations for them. Half of the recommendations will be generated from the sequence recommender, the other half from parallel based recommender. They will be displayed intermixed together. There should be more clicks on the recommendations generated from the parallel recommender than from the sequence one. The recommended objects will be logged in the database. The recommendations generated from the two recommenders can be evaluated against each other

Extended version was published in Proc. of the 10th Student Research Conference in Informatics and Information Technologies (IIT.SRC 2014), STU Bratislava, 113-118.

Acknowledgement. This work was partially supported by the Scientific Grant Agency of Slovak Republic, grant No. VG1/0675/11.

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