Investigating Usage of Resources in LMS with Specific Association Rules

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Learning Management Systems (LMS) are widely used to support face to face as well as on-line teaching. In several courses we have observed that students make decreasing use of the resources uploaded for them in the system as the semester progresses. We want to investigate whether a core group of students emerges that keep using the resources or whether, on the contrary, students are eclectic in their choice, consulting resources randomly though they use them less as the semester progresses. This paper introduces specific association rules to investigate this pattern. High confidence of these rules, confirmed by a good rating of other interestingness measures, means that a core group emerges. Support of these rules does not play any role; in fact these rules could be rare.

In the Beuth University of Applied Sciences in Berlin teaching is supported by the use of a Learning Management Systems (LMS), in our case Moodle. Some teachers are interested in knowing how their students learn with the help of all the resources they put on-line for them. A first step in answering this question is to calculate some simple statistics showing the use of resources by students. While displaying these statistics we have come across an interesting pattern like the one depicted in Figure 1 concerning non-compulsory self-tests, here `ex1` to `ex7`, that teachers make available during the semester. This pattern indicates that the number of students attempting these self-tests decreases during the semester.

We are interested in investigating this pattern to uncover the strategy adopted by students: Are they gradually giving up completely, which means that the students who

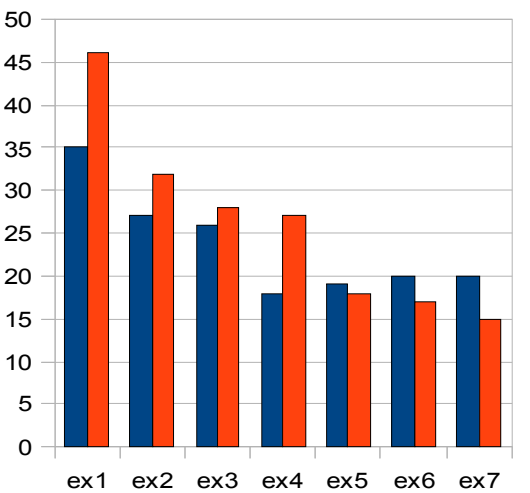

Fig. 1. Number of students attempting self-tests in 2 courses. Left: foundation of computer science , right: Java

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attempt the self-test of week *i* is roughly a sub-group of the students who attempted the self-test of week *i-1*? Or are they eclectic in their choice, which means students attempt randomly some self-tests during the semester though they attempt them less as the semester progresses? We suggest investigating this pattern with the help of specific association rules. First we propose to extract local rules of the form $X_{i+1} \rightarrow X_i$ which mean the following: If students attempt self-test *i+1*, then they also attempted the preceding one. High confidence of these rules denotes that the students who attempt self-test *i+1* form almost a subgroup of those who attempted the preceding self-test, since we are in the context in which more students have attempted self-test *i* than self-test *i+1*. When confidence of these local rules is high we propose to go ahead extracting global rules of the form $X_{i+1} \rightarrow X_i, X_{i-1}, ..., X_1$, which mean the following: If students attempt self-test *i+1*, then they also attempted all the preceding ones. High confidence of these rules denotes the emergence of a core group that keeps attempting the self-tests. Support of these specific rules is not relevant. It could be low leading to the discovery of rare association rules [KohRountree].

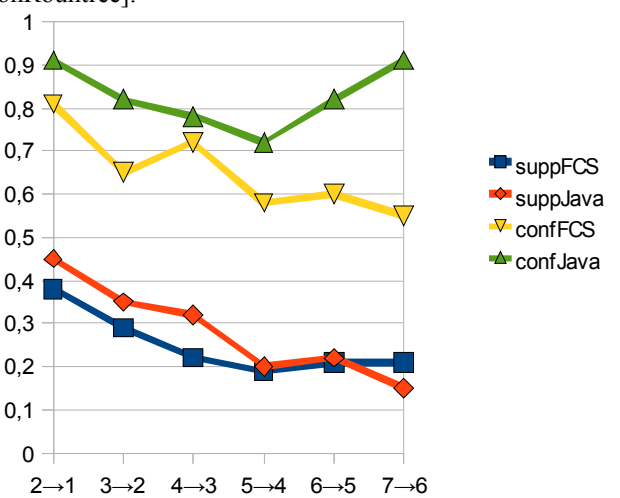

Fig. 2. Support and confidence of local rules.

Figure 2 shows support and confidence of local association rules. *2→1* means if students attempt the second self-test, they attempt the first one. One notices at a glance that support for both courses keeps decreasing as expected. Confidence is high for the Java course suggesting the emergence of a core group, which is less true for the foundation course. Local rules of the Java course have been rated as interesting by three other measures of interestingness. Confidence of the global rules for the foundation course is low while it is mainly above 0.6 for the Java course. Students have adopted different strategies in these two courses. Local and global association rules can be used for any kind of resources when usage over time indicates a drop similar to the one of Figure 1.

REFERENCES

Koh, Y. S., and Rountree, N. (Eds.).2010. Rare Association Rule Mining and Knowledge Discovery: Technologies for Infrequent and Critical Event Detection. IGI Global, ISBN9781605667546