

# ASquare: A Powerful Evaluation Tool for Adaptive Hypermedia Course System

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## ABSTRACT

Currently many methods and tools are being developed to support e-Learning courses. On the one hand, they are used to help students. On the other, a few applications are being developed to help course designers and instructors. In addition, the development of these applications is important for improving the performance of the course. Thus, we proposed in this paper to use data mining methods to aid in the designing of adaptive courses and the evaluation of their effectiveness. Lastly, the results of the implementation of our tool and examples of the utility of Data Mining for teachers is given.

## Categories and Subject Descriptors

H.3.4 [Systems and Software]: Performance evaluation (efficiency and effectiveness); H.5.2 [User Interfaces]: User-centered design; H.5.4 [Hypertext/Hypermedia]: User issues; H.2.8 [Database Applications]: Data mining; I.5 [PATTERN RECOGNITION]: General

## General Terms

Human Factors, performance

## Keywords

Evaluation, educational, decision trees

## 1. INTRODUCTION

Educational Systems provide different ways of teaching and learning to instructors and students. In particular, Adaptive Educational Hypermedia (AEH) Systems [3] automatically guide and recommend teaching activities to each student according to their personal preferences (for example: cultural background, learning styles, previous knowledge, etc.) and needs in order to improve the learning process for each student. Many AEH systems have been developed, and have been successfully implemented in different contexts. Some examples of these systems are: AHA! [5], TANGOW [4], WHURLE [6] and QuizGuide [8].

Usually AEH systems produce a large amount of data about the interaction of students with the system (interaction-

data). A lot of information about the students can be found in these data such as, student results in activities and behaviors. Therefore, it would be advantageous to analyze this interaction-data. However, this analysis is difficult without the help of automatic tools. Thus, data mining techniques provide tools and methods for analysing and discovering patterns in data [10]. Specifically, patterns of students who did not successfully complete activities relevant to learning and the evaluation of the course effectiveness. In this paper, we propose to use the new features of **ASquare (Author Assistant)**, an evaluation tool that allows the detection of student patterns and how these patterns are related to adaptation.

This paper is organized as follows: the next section briefly describes the evaluation tool; section three describes a method for testing this tool; the last section exposes conclusions and future work.

## 2. THE EVALUATION TOOL

Our previous work is centred on finding techniques and methods to evaluate different problems of adaptation in an Adaptive Hypermedia course. Various Data Mining methods such as associations rules and decision trees were tested in order to obtain a reliable method [9]. Afterwards, we developed an evaluation tool for Adaptive Hypermedia Systems, called **ASquare**, which includes the previous Data Mining methods. Therefore, the evaluation tool is able to detect unusual patterns of student behavior, possibly related with problems on the adaptation of the contents of the activities or in the structure of the adaptive course<sup>1</sup> by using two Data Mining techniques: decision trees and association rules. However, the technique of decision trees produces huge trees that are very difficult to interpret. With the purpose of solving the previous problems, a new method was forged. The method consist of applying a group of filters to the data before their processing with decision trees [2].

In this paper we present the new features of ASquare. Currently, ASquare uses an implementation of the C4.5 algorithm [7] for decision tree construction with additional filters. Therefore, ASquare is now more powerful and can process more complex data. In figure 1 ASquare displays

<sup>1</sup>An adaptive course is usually composed by a group of connected activities. An activity is composed by learning units. A learning unit contains theoretical or practical (quizzes, exercises) contents. The structure of an adaptive course covers activities and the relationship among them

a user interface divided into three panes. The first pane is the decision tree, second displays the detected problems, and the last pane provides suggestions for solving the adaptation problems.

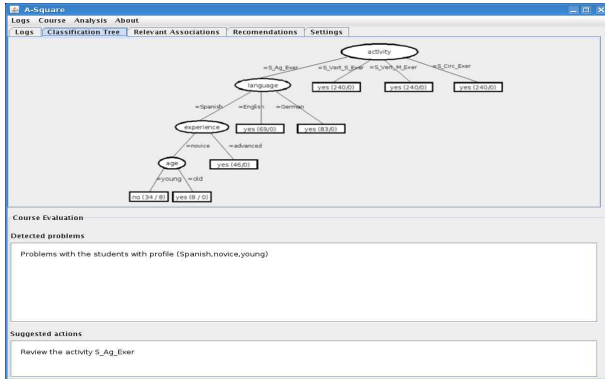


Figure 1: Interface of ASquare

### 3. TESTING THE TOOL

An important task is to test the tool with different profiles of students, i.e. students with different skills. The first step consisted of generating interaction-data of different groups of students. *Simulog* (SIMulation of User LOGs) [1] was used for creating anomalous patterns in this step. In fact, Simulog can generate synthetic logs imitating the files recorded when a student interacts with TANGOW system. The second step was to test ASquare with the logs generated by Simulog in order to detect anomalous patterns. The last step consisted of checking if ASquare was able to detect the unusual patterns generated by Simulog. After these tests, ASquare was able to detect anomalous patterns generated by Simulog. For example, Simulog generated anomalous patterns for young students with novice experience in the Spanish version of a given practical (evaluable) activity. Afterwards, ASquare detected the same problem with novice users in the logs generated through Simulog. Therefore, ASquare produced acceptable results because it found the same unusual patterns which were generated by Simulog.

### 4. CONCLUSIONS AND FUTURE WORK

This paper introduced a course system evaluation tool as well as a method to assess the accuracy of ASquare results. ASquare was able to detect the anomalous patterns prefixed by Simulog. Thus, ASquare was tested with positive results. However, it would be desirable to test ASquare with real student interactions. Currently, Javier Bravo is collaborating with the PAWS (Personalized Adaptive Web Systems), Dept. of Information Science and Telecommunications, School of Information Sciences, University of Pittsburgh. In this collaboration, the log files of tools of the PAWS group is being utilized to conduct the analysis with ASquare.

### 5. ACKNOWLEDGMENTS

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