The Development of An Educational Data Mining Environment for The Analyses of Moodle Data

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Background

Teachers use learning management systems (LMS) as a supplement for the education of their students by using LMS solutions that can involve attributes such as the administration of assignments, quizzes, discussion forums, and other leaning materials. Although LMS's, such as Moodle, usually produce statistic reports that are only useful for administrative purposes, these reports however do not assist instructors in making interpretations about the course potential or student abilities (1). In other words, LMS's are not primarily designed with data mining, analysis, or modeling in mind, because the data is not stored in a systematic way and requires thorough pre-processing and analysis (1). The main goal of this research will be the design and implementation of a data mining environment for the easy extraction, visualization, and analyses of Moodle usage data. The desired results of this research are cluster models based on student behavior in the Moodle electronic distance-learning (e-learning) environment that can assist the interpretation of strengths, weaknesses, and cognitive styles of leaning or teaching for the improvement of students and teachers, as well as clustering students and teachers into groups based on performance. Data Mining is the process of extraction and manipulation of data, and extraction of information from that data. This research involved Educational Data Mining, or the design and application of a data mining environment for the extraction, analysis, and interpretation of student data from an e-learning environment. This was achieved by creating cluster models generated by inputting data from these attributes into a RapidMiner process (1 - 4). RapidMiner is a data mining software application. The model building process in this application includes the use of operators involving data retrieval, data preprocessing, the application of the Decision Tree Algorithm, algorithm performance evaluation, and parameter optimization. When these models are interpreted they could be used to group students and predicting their success.

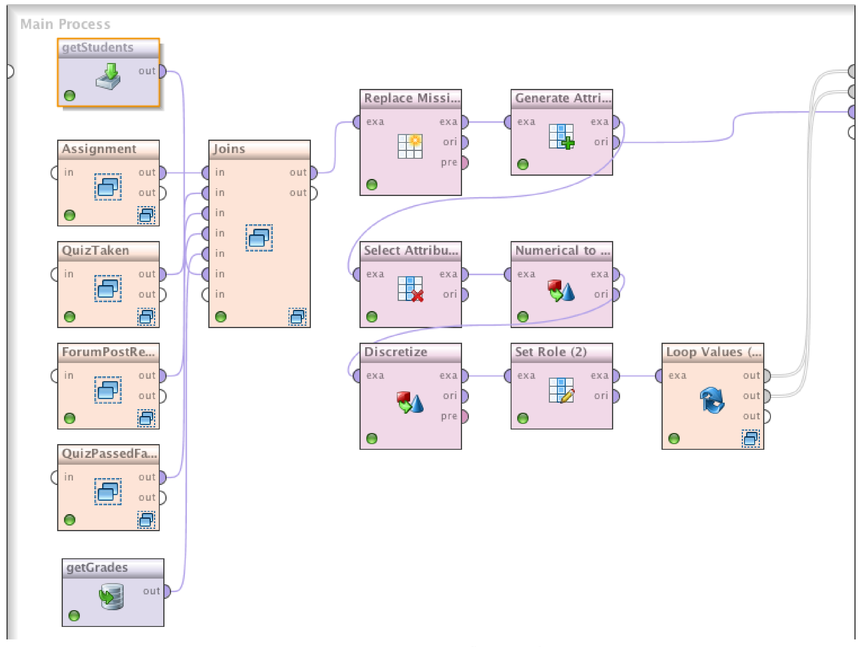
Moodle

Moodle is an open source Learning Management System that is mostly regarded as Course Management System by the open community and is dominantly used by universities (1). Teachers use learning management systems as a supplement for the education of their students by using LMS tools, which can involve attributes such as the administration of assignments, quizzes, discussion forums, and other leaning materials.

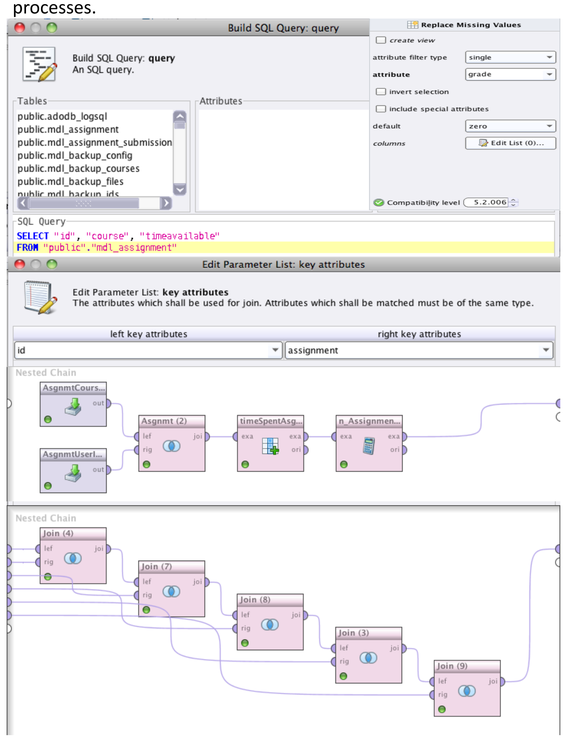
Procedure

The RapidMiner model building process:
- Data Retrieval
- Data Preprocessing
- Parameter Optimization
- Data Modeling
- Algorithm Performance Evaluation
- Decision Tree Algorithm

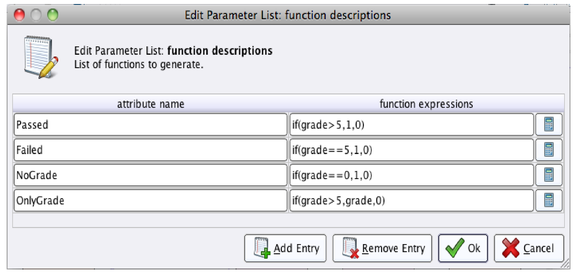
Main Process



Data Retrieval and Preprocessing: Examples of this these methods include operators for retrieving data from the database using SQL queries, replacing missing values, joining, and sub-processes.

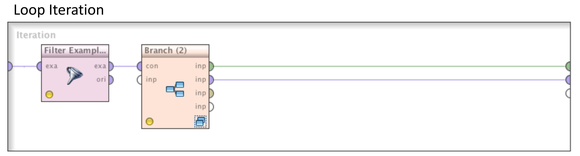


Parameter Optimization: Generate Attributes

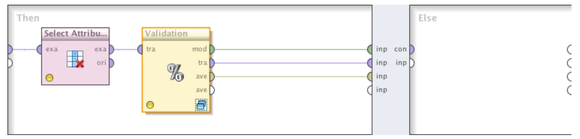


Modeling & Algorithm Performance Evaluation:

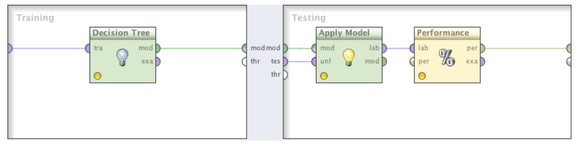
Loop Iteration



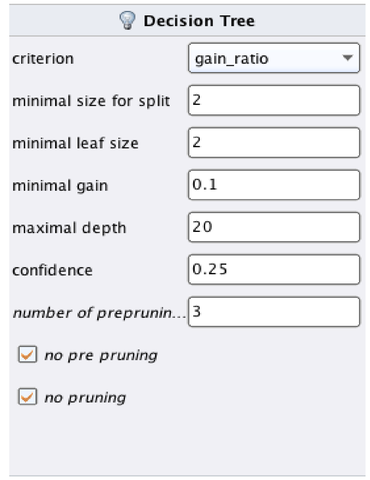
Branch



Cross Validation



Algorithm Application: Decision Tree



Results and Conclusion

Our research results of these five course models are that students' utilization of an LMS can improve student success in distance learning courses. These course models indicated that there are certain Moodle attributes that differ in each course that hold the most weight in student success. Three out of the five courses indicated that increased participation in these attributes will determine weather the student passes or fails the course. Cluster models described in this paper should assist educational institutions with engaging students who are likely to become excellent on a selected topic, and classifying students into groups that may enable better adaption of the learning materials, improve teaching methods, as well as assist collaborative learning (1).

Result Example: *Course 5's Cluster Model*

	cluster	count(assi...	sum(timeS...	count(quiz)	sum(timeS...	ForumPost	ForumRead	count(quiz...	count(quiz...	Passed	Failed	NoGrade
1	cluster_0	2.921	0.279	0.974	0.000	1.605	?	0.605	?	0	0	1
2	cluster_1	0	0	0.077	0.000	0	?	0.077	?	0	1	0
3	cluster_2	0.310	0.020	0.103	0.000	0.069	?	0.069	?	1	0	0

Cluster 0 (No Grade): These students display the most Moodle activity, but either most of them did not *yet* complete the course requirements in order to receive a final course grade, or their final course grade was not recorded in Moodle.
Cluster 1 (Failed): These students displayed the least Moodle activity and most of them failed the course.
Cluster 2 (Passed): These students display the 2nd most Moodle activity and most of them passed the course.
General Interpretation:
- This data set has the least attributes with missing values.
- Missing values for forum read and quiz failed count.

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Works Cited

Jovanovic, Milos, Milan Vukicevic, Milos Milovanovic, and Miroslav Minovic. "Using Data Mining on Student Behavior and Cognitive Style Data for Improving E-learning Systems: A Case Study." International Journal of Computational Intelligence Systems 5.3 (2012): n. pag. Web
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