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DATA MINING IN HIGHER EDUCATION: A SURVEY

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ABSTRACT

The main objective of higher education is to make our students self-sufficient and enable them to do what they want. And the higher education which is being given to our students is relevant or not. So, one way to achieve highest level of quality in higher education system is by discovering knowledge hidden among the educational data set and to make future prediction using data mining techniques. The knowledge pertains to admission of students in a particular course, classroom teaching model, detection of unfair means and prediction about students' performance and so on. This paper shows the capabilities of data mining techniques in context of higher education and presents a survey of research in this field.

KEYWORDS

Association rule, Clustering, Classification, Data mining, Outlier detection.

INTRODUCTION

One of the biggest challenges that higher education faces today is to predict the paths to be followed by the students. Educational data mining (EDM) is an emerging discipline that focuses on applying data mining tools and techniques to educationally related data. Institutions would like to know which students will enroll in particular course programs, which students will need assistance in order to graduate, and others who are likely to get transfer. The discipline focuses on analyzing educational data to develop models for improving learning experiences and improving institutional effectiveness. One way to effectively address these student challenges is through the analysis and presentation of data, or data mining. Data mining enables organizations to use their current reporting capabilities to uncover and understand hidden patterns in vast databases. These patterns are then built into data mining models and used to predict individual behavior with high accuracy. As a result of this insight, institutions are able to allocate resources and staff more effectively. This paper addresses the capabilities of data mining and its applications in higher education. A literature review on educational data mining follows, and gaps in the current literature and opportunities for further research are presented.

THE DATA MINING PROCESS

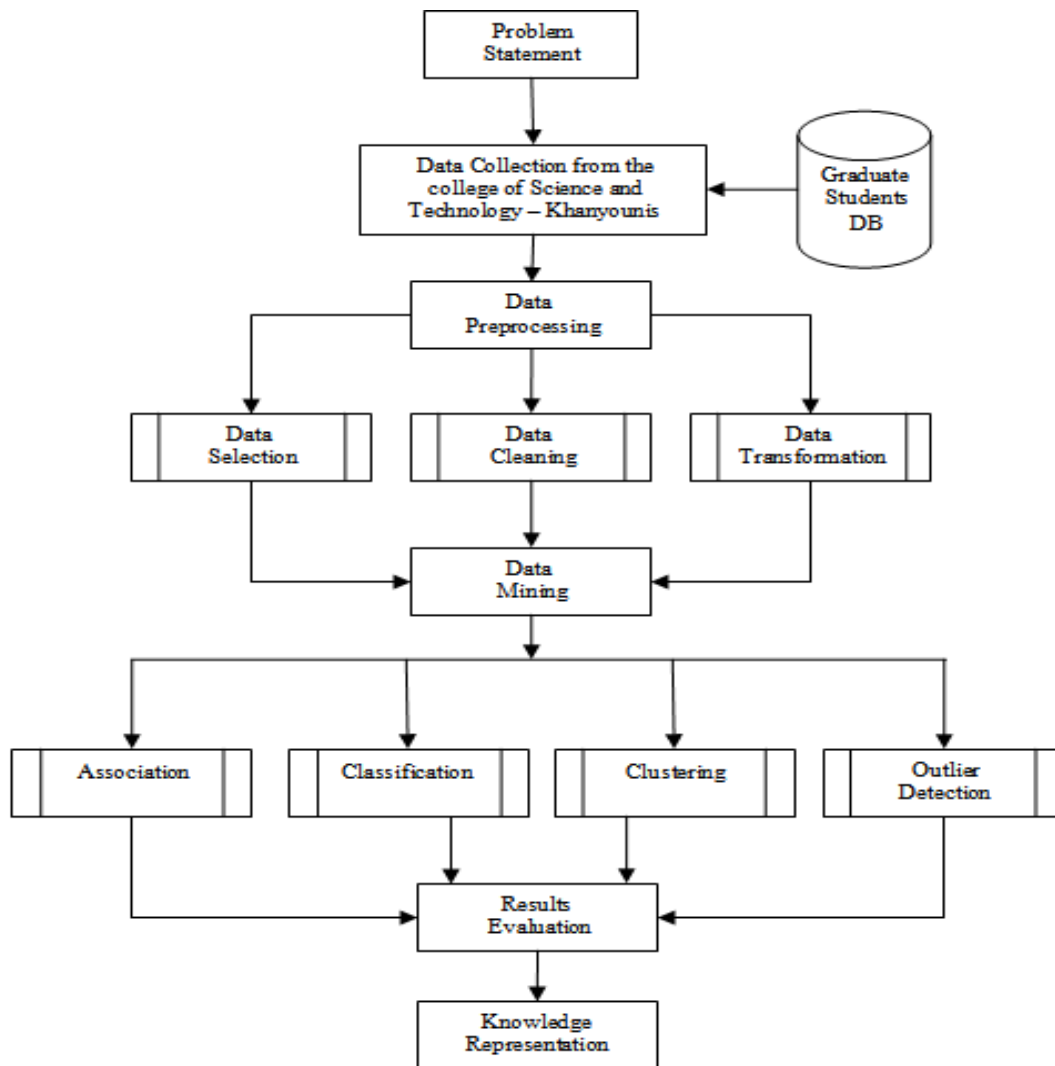
Big data is a term that describes the growth of the amount of data that is available to an organization and the potential to discover new insights when analyzing the data. Organizations have a challenge of sifting through all of that information, and need solutions to do so. Data mining uses a combination of an explicit knowledge base, sophisticated analytical skills, and domain knowledge to uncover hidden trends and patterns. These trends and patterns form the basis of predictive models that enable analysts to produce new observations from existing data.

Data mining can assist organizations with uncovering useful information in order to guide decision-making 1.(Kiron, Shockley, Kruschwitz, Finch, & Haydock, 2012). Data mining is a series of tools and techniques for uncovering hidden patterns and relationships among data 2. (Dunham, 2003). Data mining is also one step in an overall knowledge discovery process, where organizations want to discover new information from the data in order to aid in decision-making processes. Knowledge discovery and data mining can be thought of as tools of decision-making and organizational effectiveness.

There are a variety of different data mining techniques and approaches, such as clustering, classification, and association rule mining. Each of these approaches can be used to quantitatively analyze large data sets to find hidden meaning and patterns. Data mining should be performed on very large or raw datasets using either supervised or unsupervised data mining algorithms. Note that data mining cannot occur without direct interaction with unitary data. Data mining is different from other searching and analysis techniques as Data mining is highly exploratory, whereas other analyses are typically problem-driven and confirmatory.

Data mining, also popularly known as Knowledge Discovery in Database, refers to extracting or "mining" knowledge from large amounts of data. While data mining and knowledge discovery in database are frequently treated as synonyms, data mining is actually part of the knowledge discovery process. The knowledge discovery process consists of the following steps:

FIG. 1



Various algorithms and techniques like Classification, Clustering, Regression, Artificial Intelligence, Association Rules, Decision Trees, Nearest Neighbor method etc., are used for knowledge discovery from databases. These techniques and methods in data mining need brief mention to have better understanding.

A. Classification

Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at large. This approach frequently employs decision tree or neural network-based classification algorithms. The data classification process involves learning and classification. In Learning the training data are analyzed by classification algorithm. In classification test data are used to estimate the accuracy of the classification rules. If the accuracy is acceptable the rules can be applied to the new data tuples. The classifier-training algorithm uses these pre-classified examples to determine the set of parameters required for proper discrimination. The algorithm then encodes these parameters into a model called a classifier. For example : we can use a classification method to determine whether the student is excellent, very good, average or poor in his studies based on his marks secured.

B. Clustering

Clustering can be said as identification of similar classes of objects. By using clustering techniques we can further identify dense and sparse regions in object space and can discover overall distribution pattern and correlations among data attributes. Classification approach can also be used for effective means of distinguishing groups or classes of object but it becomes costly so clustering can be used as preprocessing approach for attribute subset selection and classification. Clustering is often confused with classification, but there are differences. In classification the objects are assigned to predefined classes, where as in clustering the classes are also to be defined. Clustering methods may be divided into two categories based on the cluster structure which they produce hierarchical cluster and partitioning cluster.

C. Prediction

Regression technique can be adapted for prediction. Regression analysis can be used to model the relationship between one or more independent variables and dependent variables. In data mining independent variables are attributes already known and response variables are what we want to predict. Unfortunately, many real-world problems are not simply prediction. Therefore, more complex techniques (e.g., logistic regression, decision trees, or neural nets) may be necessary to forecast future values. The same model types can often be used for both regression and classification. For example, the CART (Classification and Regression Trees) decision tree algorithm can be used to build both classification trees (to classify categorical response variables) and regression trees (to forecast continuous response variables). Neural networks too can create both classification and regression models.

D. Association rule

Association and correlation is usually to find frequent item set findings among large data sets. This type of finding helps businesses to make certain decisions, such as catalogue design, cross marketing and customer shopping behavior analysis. Association Rule algorithms need to be able to generate rules with confidence values less than one. However the number of possible Association Rules for a given dataset is generally very large and a high proportion of the rules are usually of little (if any) value. By making use of support and confidence parameters we can find out the hidden association among the variables.

E. Decision Trees

Decision tree is tree-shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset. Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID).

F. Outlier Detection

This method is used to detect outliers in the student dataset. Distance-based approach identifies the number of outliers in the given data set based on the distance to their k nearest neighbors, and the result of applying this method is to flag the records either to be outlier or not, with true or false value [10]. Density-based approach computes local densities of particular regions and declares instances in low density regions as potential outliers.

RELATED WORK

Although, using data mining in higher education is a recent research field, there are many works in this area. That is because of its potential to educational institutes.

Romero and Ventura [5], have a survey on educational data mining between 1995 and 2005. They concluded that educational data mining is a promising area of research and it has a specific requirements not presented in other domains. Thus, work should be oriented towards educational domain of data mining.

Han and Kamber [3] describes data mining software that allow the users to analyze data from different dimensions, categorize it and summarize the relationships which are identified during the mining process.

El-Halees [5], gave a case study that used educational data mining to analyze students' learning behavior. The goal of his study is to show how useful data mining can be used in higher education to improve student' performance. He used students' data from database course and collected all available data including personal records and academic records of students, course records and data came from e-learning system. Then, he applied data mining techniques to discover many kinds of knowledge such as association rules and classification rules using decision tree. Also he clustered the student into groups using EM clustering, and detected all outliers in the data using outlier analysis. Finally, he presented how can we benefited from the discovered knowledge to improve the performance of student.

Baradwaj and Pal [6], applied the classification as data mining technique to evaluate student' performance, they used decision tree method for classification. The goal of their study is to extract knowledge that describes students' performance in end semester examination. They used students' data from the student' previous database including Attendance, Class test, Seminar and Assignment marks. This study helps earlier in identifying the dropouts and students who need special attention and allow the teacher to provide appropriate advising.

Shannaq et al. [7], applied the classification as data mining technique to predict the numbers of enrolled students by evaluating academic data from enrolled students to study the main attributes that may affect the students' loyalty (number of enrolled students). The extracted classification rules are based on the decision tree as a classification method, the extracted classification rules are studied and evaluated using different evaluation methods. It allows the University management to prepare necessary resources for the new enrolled students and indicates at an early stage which type of students will potentially be enrolled and what areas to concentrate upon in higher education systems for support.

Chandra and Nandhini [8], applied the association rule mining analysis based on students' failed courses to identifies students' failure patterns. The goal of their study is to identify hidden relationship between the failed courses and suggests relevant causes of the failure to improve the low capacity students' performances. The extracted association rules reveal some hidden patterns of students' failed courses which could serve as a foundation stone for academic planners in making academic decisions and an aid in the curriculum re-structuring and modification with a view to improving students' performance and reducing failure rate.

Ayesha et al. [9], used k-means clustering algorithm as a data mining technique to predict students' learning activities in a students' database including class quizzes, mid and final exam and assignments. These correlated information will be conveyed to the class teacher before the conduction of final exam. This study helps the teachers to reduce the failing ratio by taking appropriate steps at right time and improve the performance of students.

Bray [4], in his study on private tutoring and its implications, observed that the percentage of students receiving private tutoring in India was relatively higher than in Malaysia, Singapore, Japan, China and Sri Lanka. It was also observed that there was an enhancement of academic performance with the intensity of private tutoring and this variation of intensity of private tutoring depends on the collective factor namely socio-economic conditions.

CONCLUSION & FUTURE WORK

This paper showed how data mining can be used in higher education particularly to improve graduate students' performance. The data mining techniques can be used to discover knowledge. We can use classification to predict the Grade of the graduate student and cluster the students into groups using K-Means clustering algorithm, outlier detection can be used to detect all outliers in the data. Each one of these tasks can be used to improve the performance of graduate student.

The future work include applying different data mining techniques like neural nets, genetic algorithms, k-nearest Neighbor, etc. and also apply these on huge data set with more distinctive variables to get more accurate results.

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Thanking you profoundly

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Sd/-

Co-ordinator

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