Machine Learning Approaches Generate Question Based on Course Learning Outcome & Blooms Taxonomy

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Abstract

The need for advancement in e-learning technology causes educational data to become very huge and increase rapidly. The data is generated on daily basis as a result of students' interaction with learning management systems. So, Outcome-based education (OBE) is uniquely adapted by most of the educators across the world for objective processing, evaluation and assessment of computing programs and its students. However, the extraction of knowledge from OBE in common is a challenging task because of the scattered nature of the data obtained through Course Learning Outcomes (CLOs). Massive Open Online Courses have become an alternative educational platform that allows learners from dispersed geographic locations access the same quality of learning through the web. A large number of students globally go through e-learning web application for assessment. They enroll courses. Teachers are assessing students through online exam applications, Despite the flexible accessibility, results indicate that the completion rate is quite not so bad. This paper is aimed at predicting Question paper' based on questions CLO & difficulty level. Students interaction in e-learning environment, random question paper for each, their assessment exam types (quiz, assignment, mid-term, final, mock test etc.) as prediction features. Decision Tree algorithm has been used for the prediction. Results show that the algorithm predicts a question paper successfully and with accuracy of 90-100%.

***Keywords*: OBE, CLO, prediction, online exam system (OES), question generator(QG), Automatic Question generator(**AQG)

I. INTRODUCTION

Student performance in educational institutions such as Universities and Colleges is not only a pointer to the effectiveness of the institutions but also major determinant of the future of students in particular and nations at large. Learning outcomes have become phenomenon of interest to all and this account for the reason why scholars have been working hard to find out factors that militate against good academic performance [10]. As a result, academic achievement of learners has attracted attention of scholars, parents, policymakers and planners, their goal is to work hard towards attainment of academic excellence by students. By conducting online examinations one can easily **save** paper i.e. save trees. It is easy, nature-friendly and cost-effective. It gives instant results: The computerized system gives you instant and accurate results which save you lot of time waiting for results like in traditional exams. So, OES is necessary for educational institutes and remote teaching and assessment. Outcome-based education (OBE) is an educational theory that relates every single activity involved in education to discrete goals and objectives [2]. In OBE, the student is taught and assessed through a rigorous process, and the outcomes achieved at the end of the process should demonstrate the achievements of the goals and objectives [9]. OBE is adopted by different countries mostly in education related to engineering, technology and

computing [11]. Machine learning offers an advantage over traditional forms of statistical analysis, placing emphasis on predictive performance over provable theoretical properties and priori super-population assumptions [1]. Moreover, a key feature of machine learning is the capacity to analyses complex non- linear relationships, given that complex input variables are expected [4], [7]. Various supervised machine learning approaches have been conducted in this study to predict the learning outcome in Massive Open Online Courses. This paper therefore focuses on developing prediction model of question paper' Question paper based on teachers question rating with online exam system (OES) in order to explore the performance of Decision Tree in the prediction of student question paper with the aim of achieving high prediction accuracy. The reminder of this paper is organized as follows. Section II will provide detailed information about previous works, while section III shows the methodology, which includes data descriptions, data preprocessing, data analysis, and experiment setup. The conclusion and future works are described in Section IV.

II. RELATED WORKS

OES is a computerized system which gives instant results and also saves time. It fully automates the previous manual process of taking written exams. schemes. Students can study independently for example at home or any place. The entire process of allocating test and analyzing their scores after the test was operated manually for example examining test and distributing score which used to take a lot of time when online examination was not in existence. To take written exam of number of students we need more invigilators to watch examination candidates for the purpose of reducing or preventing cheating. It is developed for reducing large number of relevant resources. Online Examination System is developed base on web and network. It recognizes the concept of design system that characterizes the main purpose of the system, examining the algorithm of creating question paper and also about the security of the system. Most of these systems also have the ability to collect data about the student activities, tracking navigational pathways through educational resources, time spent on various topics, or number of visits. The method of online examination was for important activities like to evaluate performance of student in existing institutes. The exam question quality of online examination will regulate or decide the quality of students growing in the institutes. Present technologies as familiar with advanced techniques like adding question bank in database. Teacher will provide questions with CLO and evaluate question as difficulty level. It also helps to originate or generate the different questions in sets without repeating and reducing the duplication of questions. In OES, the use of Decision Tree algorithm to predicts the question paper can prevent malpractice to minimum, make it easy for teachers and the OES characterize the use of shuffling algorithm is a Generator Question System (GQS) as one of the techniques used to overcome randomization issues of collecting sets of exam paper.

III. METHODOLOGY.

A. Decision Tree

Decision tree classification is one of the popular algorithms of supervised classification used for data mining of large datasets. It is a hierarchical structure that maps the hierarchy of decision rules. The tree is constructed by dividing the obtained training set based on a specific criterion. Decision tree (DT) is one of the most popular learning and reasoning methods from feature-based examples. It is a predictive model in which branches represent all possible conditions and the leave nodes represent the class values. ID3, C4.5 and CART are the different algorithms that are used for classification of the decision tree [6]. To construct a decision by using a decision tree classification algorithm (whether ID3, C4.5, C5.0 or CART), the given dataset must be labeled with discrete class outputs, which makes the decision tree a supervised classification method. ID3 takes only ordinal values for constructing a hierarchical structure feasible for decision-making. In all the algorithms of DT classification, the attributes to be mapped on DT are selected based on attribute selection measures. Attribute selection measures select an attribute out of many to construct decision tree upon it. Another measure used in DT is entropy which is used to find the level of disorder in a dataset. The procedure to construct a decision tree using entropy is given below. Gini Index is another attribute selection measure in which impurity-based criterion that measures the divergence between the probability distributions of the target attribute's values is taken for selecting an attribute. Gini index measures the impurity in dataset, that is, how often a randomly chosen element would be incorrectly labeled if it were randomly labeled according to the subset. It is calculated by summing the probability of each item being chosen times the probability of mistakes in categorizing them. ID3 uses information gain as attribute selection measure, whereas C4.5 uses gini index [8]. The INTERACTIVE LEARNING ENVIRONMENTS
7 algorithm for constructing a decision tree based on these attribute selection measures is given below.
Let there be a subset dataset X which contains m samples X= {x1, x2, x3, … , xm}. Suppose that the dataset X is labeled by distinct class labels k (1,2,3, … , k). Let xi be the number of samples of X having class label

i. Step 1: Calculate the information gain (IG)/Gini Index of each of the given attribute in the dataset X. Select the test attribute at each node of the tree.

$$IG = -\sum_{i=1}^{n} Pi \log 2\ Pi \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

where Pi is the probability of sample belonging to an individual class and
Pi = xi /x.

$$IG = -\sum(xi/x) \log 2\ (xi/x) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Step 2: The entropy (E) is calculated on the basis of dataset partitioning.

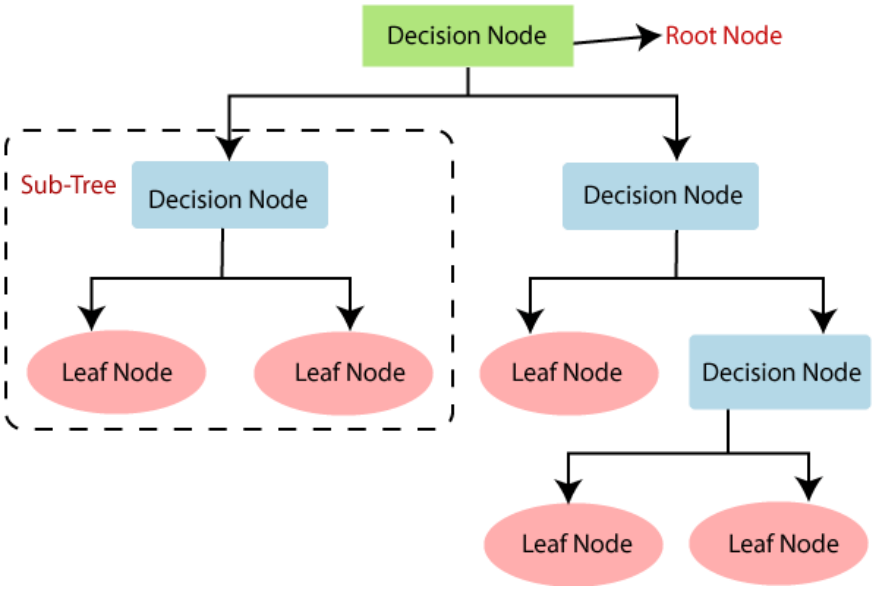
$$E = -\sum_{1=1}^{n}(x1i + \cdots\ xmi)/x \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Step 3: Calculate the total gain of the attribute.

$$TG = (IG - E) \quad \text{……..……...……(5)}$$

Step 4: The attribute with the largest total gain will be selected at that node.

The details of decision tree classification algorithms can be seen in (Han et al., 2012).



B. Data description

For the purpose of this research, only the teacher's interaction data on the examination activities, teachers' prerequisite knowledge and assessment were selected because they provide information on the questions. students' participation in the examination impact of assessment on students' performance. The basis for selecting these attributes is for judging the question. For the purpose of this research, the data altogether consist of 1000 question' records and a total of eleven (5) attributes were selected including the class attribute, these attributes were the tag of a question. Table I gives a description of the selected attributes.

TABLE I. Attributes Description

SN	**Attribute**	**Description**
1	Course_code	Teacher registered course id
2	Course_lesson	Specific lesson of the course
3	Question_complexity_level	Numeric difficulty of the question
4	Question_clo	Which assigned course learning outcome question belongs

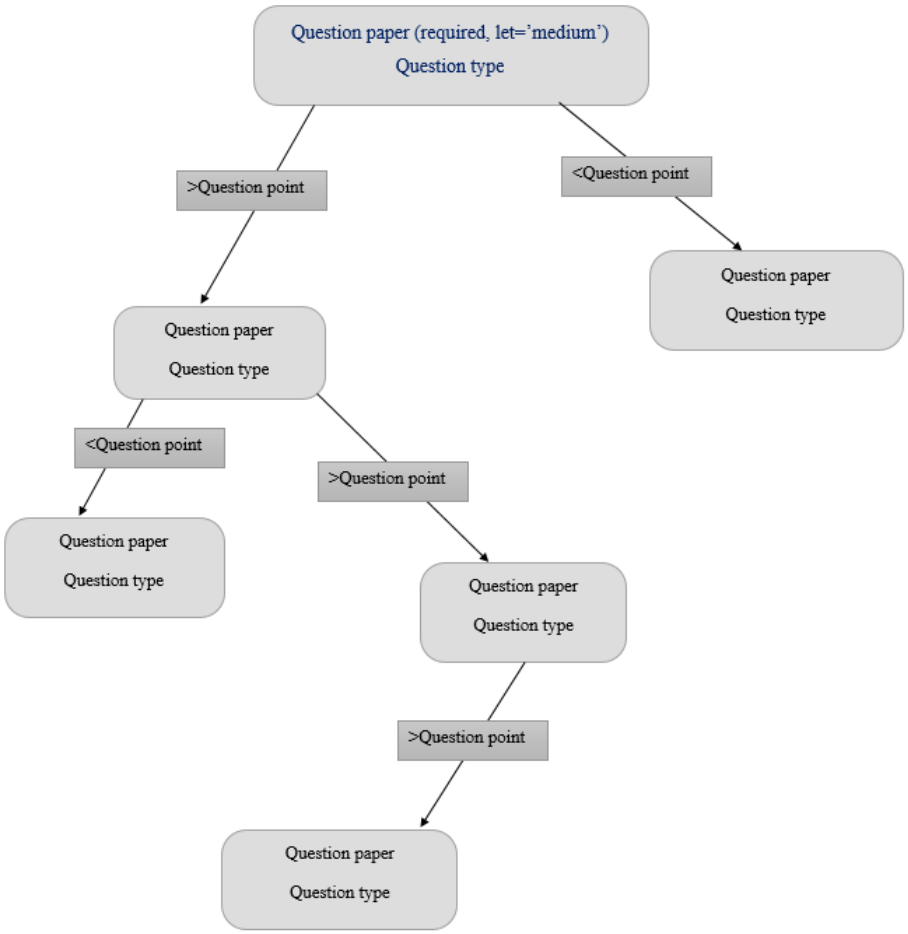
5	Question	Class

The difficulty level of questions while generating question paper, its prerequisite questions in the database, from which the agent selects questions according to the difficulty level determined by the examiner [5].

C. Exploratory Data Analysis

The data used in this study consists of 300-log file. Around 5000 dummy data in CSV. 1000Questions for functional testing.

A Demo how decision tree predicts questions to generate a required question paper.



First we need to convert a question from question bank to numerical value.
Then we can fit the value in decision tree algorithm.
So, lets complexity level= A; Question count =B, how many question for required exam C;

$$(A*B) + C$$

There will be highest number of question which difficulty is greater then others, that = D;

$$\frac{(A*B) + C}{D\text{-}A}$$

That's how we get a virtual numerical value for the question, now this value can be fit into ml models.

First we have to make our dataset is clean. Drop anything that looks like unnecessary, that's how you can increase the measure and it will be time consuming. First we need to be in shape (dataset) for experimenting.

D. Experiment setup

The method implemented in this paper follows a binary classification problem. Various linear and nonlinear supervised machine learning has been employed to predict if the learner obtain certification. Machine Learning models are Logistic Regression (LR), Linear Discriminant Analysis (LDA), Naive Bayes (NB), Decision Tree (DT), Random Forest (RF)Table II illustrates a brief description of the models used in this study.

TABLE II. Attributes Description

Model	Description	Architecture	Type	Algorithm
DT	Decision Tree	Recursive partition Decision rules	Nonlinear	C4.5 algorithm
LG	Logistic regression	Generalized Linear Model	Linear	Maximum Likelihood Estimation
RF	Random Forest	Ensemble DT	Nonlinear	Random subset Features Bootstrap
NB Rule	Naive Bayes	Bayesian Decision	Linear	Maximum Likelihood Estimation
LDA	Linear Discriminant Analysis	Generalized Linear Model	Linear	Maximum Likelihood Estimation

IV. CONCLUSION AND FUTURE WORK.

This paper considers the similarity measurement approach that is necessary for assessing the difficulty levels of quizzes in the AQG system and We can depend on machine to predicts the question. Focused on the text file from user's which contains text, upon which user desires to fetch questions. The output is produced in form of a text file containing questions based on Bloom's taxonomy [3]. The entire process is carried out by software agents, which eliminates the major problems. We have described how our proposed method can achieve the greater number of difficulty levels by taking advantages on the object-based methods for finding the accuracy. The benefit will be on enabling a fine granularity of choices in exams generated automatically from the AQG system. Now, Using Question evaluation is easy way to train the Machine and in future we don't have to put questions in the systems anymore. The simulation results in both experiments indicate that Decision Tree and LG achieved ideal performance, with the accuracy values of 0.9881 and 0.8651 respectively. Other classifier models gave lower performance. The results show that machine learning is a viable approach to our problem, providing an exceptional capability to distinguish between success and failure outcomes. Two set of experiments have been compared in term of computational performance. The result shows average run time of machine learning models is much longer in first experiment than second experiment. Future work will investigate passive engagement within OES in terms of the effect on learning outcome. The learner emotional states of Machine are considered to be a latent variable, which can be feed more and more over time. We will construct a robust predictive model.

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