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Improving the Student's Performance Using Educational Data Mining

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----------**ABSTRACT**----------

The main goal of educational data mining is to improve the student performance. The usage of data mining techniques which achieves the goal in an efficient manner. The discovery of knowledge that extract from the end semester [1] is one of the method for improving the quality of higher education. In the higher education, the analysis on enrolment of student's performance in a particular course, the student talent, confidence, studies and ethic helps to get more knowledge. In this research, the data classification and decision tree [1] which helps to improve the student's performance in a better way. But with the inclusion of extracurricular activities with the above data mining techniques makes quality of education in an easiest way. This type of approach gives high confidence to students in their studies. This method helps to identify the students who need special advising or counseling by the teacher which gives high quality of education.

Keywords – ***Classification, Educational Data Mining (EDM), ID3 Algorithm, Knowledge Discovery in Database (KDD)***

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1. Introduction

Data mining is the powerful technology for analyzing important information from the data warehouse. It is the extraction of hidden predictive information for better decision making. Data mining is one of the steps in KDD process. Knowledge discovery (KDD) aims at the discovery of useful information from large collections of data [2]. The main goal of data mining in the KDD process concerned with the algorithmic means by which patterns or structures are enumerated from the data under acceptable computational efficiency limitations. The new concept of educational data mining techniques, is rapidly growing [3] in the education field. It helps to make analysis on the student activities and also improves their performance.

The scope of this research paper, makes to extract the knowledge discover from the student database for improving the student performance. Here by, data mining techniques such as data classification and decision tree methods are used to evaluate the student performance. The analysis of performance can be done in several ways such as Overall Semester Marks, Practical Lab, Attendance, Paper Presentation, End Semester Marks etc.,

1.1 Decision Tree

A Decision tree is a classification Scheme which generates a tree and set rules, representing the model of different classes, from a given data set. A decision tree can be used to clarify and find an answer to a complex problem. The structure allows users to take a problem with multiple possible solutions and display it in a simple, easy-to-understand format that shows the relationship between different events or decisions. The furthest branches on the tree represent possible end results.

There are three decision tree algorithms are used to make the decision efficiently. Those are ID3, ASSISTANT and C4.5.

2. Related Work

Data mining is a powerful tool for academic intervention. 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.

On the basis of student performance Pandey and Pal [4] conducted study by selecting 600 students from different

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colleges of Dr.R.M.L. Awadh University, Faizabad, India. By means of Bayes Classification on Category, Language and background qualification, it was found that whether new comer students will performer or not.

Galit [5] gave a case study that use students data to analyze their learning behavior to predict the results and to warn students at risk before their final exams.

Bray [6], 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.

Pandey and Pal [7] conducted study on the student performance based by selecting 60 students from a degree college of Dr. R. M. L. Awadh University, Faizabad, India. By means of association rule they find the interestingness of student in opting class teaching language.

Khan [8] conducted a performance study on 400 students comprising 200 boys and 200 girls selected from the senior secondary school of Aligarh Muslim University, Aligarh, India with a main objective to establish the prognostic value of different measures of cognition, personality and demographic variables for success at higher secondary level in science stream. The selection was based on cluster sampling technique in which the entire population of interest was divided into groups, or clusters, and a random sample of these clusters was selected for further analyses. It was found that girls with high socio-economic status had relatively higher academic achievement in science stream and boys with low socio-economic status had relatively higher academic achievement in general.

Han and Kamber [9] 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.

Ayesha, Mustafa, Sattar and Khan [10] describe the use of k-means clustering algorithm to predict student□s learning activities. The information generated after the implementation of data mining technique may be helpful for instructor as well as for students.

Bhardwaj and Pal [11] conducted study on the student performance based by selecting 300 students from 5 different degree college conducting BCA (Bachelor of Computer Application) course of Dr. R. M. L. Awadh University, Faizabad, India. By means of Bayesian classification method on 17 attribute, it was found that the factors like students□ grade in senior secondary exam, living location, medium of teaching, mother's qualification, students other habit, family annual income and student□s family status were highly correlated with the student academic performance.

Al-Radaideh, et al [12] applied a decision tree model to predict the final grade of students who studied the C++ course in Yarmouk University, Jordan in the year 2005. Three different classification methods namely ID3, C4.5, and the NaïveBayes were used. The outcome of their results indicated that Decision Tree model had better prediction than other models.

3. Proposed Work

3.1 ID3 Decision Tree

The ID3 algorithm was invented by Ross Quinlan. It is a precursor to the c4.5 algorithm. We can create the decision tree in a given data set using this ID3 algorithm. This algorithm classifies the data using attributes. ID 3 follows the Occams's Razer Principle. It is used to create the smallest possible decision tree.

In an educational system student's performance can be improved by analyzing the internal assessment and end semester examination. Internal assessment means class test, seminar, attendance, lab practical would be conducted by the teacher. Along with the internal assessment, communication skill and paper presentations done by the student in their academic days are also needed to analyze for the improvement of student's performance.

3.2 Data set

The data set used is obtained from M.Sc IT department of Information Technology 2009 to 2012 batch, Hindustan College of Arts and Science, Coimbatore. First 50 student's data is taken as sample and errors were removed.

Some of the fields were selected which are required for data mining process. Some derived attributes were included. These attributes are given in Table – I.

Table – I. Selected Attributes for data set.

Attributes	Description	Possible Values
OSM	Overall Semester Marks	{ First >59%, Second >49% &<60% Third >34% & <39% Fail <40%

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CT	Class Test	{Good, Average, Poor}
SEM	Seminar Performance	{Good, Average, Poor}
CS	Communication Skill	{Good, Average, Poor}
PP	Paper Presentations	{Yes, No}
ATT	Attendance	{Good, Average, Poor}
PL	Practical Lab	{Yes, No}
ESM	End semester Marks	{ First >59%, Second >49% &<60% Third >34% & <39% Fail <40%

The values for the attributes are explained as follows for the current analysis.

1. **SM –** Overall Semester Marks are obtained from M.Sc IT. It is divided into four values: *First >59%, Second >49% and <60%, Third >34% and < 39%, Fail < 40%*.

2. **CT –** Class Test is obtained. In each semester two class tests are conducted. It is split into three classes: *Good – 60%, Average >39% and < 60% and Poor < 40%.*

3. **SEM –** Seminar Performance is obtained. Every semester seminars are organized for the improvement of student's performance. Seminar performance is divided into three classes: *Poor – Presentation and confidence are low, Average – Either presentation is good or Confidence is good, Good – Both presentation and confidence is good.*

4. CS – Communication Skill. In general the students communication skill is evaluated while taking seminars or in class rooms. Communication skill is divided into three categories: *Good – communication is nice, Average – communication is to better, Poor – communication is low.*

5. PP – Paper Presentations. At the end of the year Paper Presentations must be done by the student. Paper presentation is divided into two classes: *Yes – student participated Presentation, No – Student not participated in Presentation.*

6. ATT – Attendance is compulsory for the Students. Minimum 75% attendance is needed to participate in End Semester Examination. Attendance is divided into three classes: *Poor <60%, Average > 60% and <80%, Good >80%.*

7. Practical Lab – Practical classes are divided into two classes: *Yes – student completed Practical lab, No – student not completed Practical lab*.

8. ESM - End semester Marks obtained in M.Sc IT. It is one of the important attribute. It is divided into four values: *First >59%, Second >49% and <60%, Third >34% and < 39%, Fail < 40%*.

3.3 Impurity Measurement

In the dataset there will be several numbers of attributes and classes of attributes. The measurement of homogeneity or heterogeneity of data in the dataset is based on classes. The purity of table can be identified by, which contains only one class. The data table which consist of more than several classes are known as heterogeneous or impurity of table. There are several ways to measure impurity of table impurity in the tables. But the well method is entropy, gini index and classification error.

$$S = -\sum_{n=1}^{H} P_n \log(P_n) .$$

Hereby, the method of Entropy is used to calculate the quantitative impurity. Entropy of pure table becomes zero when the probability becomes one and it reaches maximum values when all classes in the dataset have equal probability.

3.4 Information gain

The Information gain can be increased with the average purity of the subsets which are produced by the attributes in the given data set. This measure is used to determine the best attribute for the particular node in the tree.

Selecting the new attribute and partitioning the given values will be repeated for each non terminal node. If any attribute has been incorporated higher in the tree, that attribute will be excluded. So, all of the given attributes will be appeared once in all the way throughout the tree.

In this way above process will be continued in all the leaf node till any one of the conditions are met,

(i) Each attribute is included once in all the path of the tree, or

(ii) If each attribute's entropy value is zero, the given value will be associated with the leaf node.

3.5 ID3 Algorithm

ID3 (Values given, Target_Attribute, Attributes)

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Step 1: Create a tree with root node.
Step 2: Return the single tree root node with label +, if all the given values are positive.
Step 3: Return the single tree root node with label -, if all the given values are negative.
Step 4: Return the single tree root node with label = most common values of target attributes in the given value. It can be performed when predicting attribute is empty.
Step 5: else begin

(i) A specifies best attribute in the given value.
(ii) In decision tree the root for an attribute is A
(iii) For A, each possible values Vi as,
  (a) If A = V_i add corresponding branch below root.
  (b) Let given value V_i which is subset of the given value V_i for A.
  (c) If the given value V_i is empty
    (i) Add a new leaf to the branch node which is equal to most common target value in the given value.
    (ii) Add the sub tree ID3 to this new branch node (values given V_i, Target_Attribute, Attribute).

Step 6: End the process.
Step 7: Return the root node.

4. Discussion on Result

In this analysis, the data set is obtained from the department of M.Sc IT 2009 to 2012 batch Hindusthan College of Arts and Science, Bharathiar University Affiliated, Coimbatore.

Table II. Data Set

SNO	OSM	CTM	SEM	CS	PP	ATT	LP	ESM
1	First	Good	Good	Good	Yes	Good	Yes	First
2	First	Good	Good	Good	Yes	Good	Yes	First
3	First	Good	Average	Average	Yes	Good	Yes	First
4	First	Good	Poor	Average	No	Good	No	Second
5	First	Good	Average	Average	No	Good	Yes	Second
6	First	Poor	Poor	Poor	Yes	Poor	No	Second
7	First	Average	Poor	Good	No	Average	No	Fail
8	First	Average	Good	Good	No	Average	No	Second
9	First	Average	Good	Good	No	Average	Yes	Third
10	First	Poor	Average	Average	No	Poor	Yes	Second
11	First	Poor	Average	Poor	Yes	Good	Yes	Third
12	First	Good	Average	Average	No	Poor	Yes	Second
13	First	Average	Good	Average	Yes	Poor	Yes	Second
14	First	Average	Average	Good	Yes	Poor	No	Fail
15	Second	Average	Poor	Good	Yes	Average	No	Second
16	Second	Poor	Poor	Poor	Yes	Average	Yes	Fail
17	Second	Poor	Good	Poor	No	Good	No	First
18	Second	Poor	Average	Poor	No	Good	No	First
19	Second	Good	Poor	Average	No	Good	No	Second
20	Second	Good	Good	Good	Yes	Good	Yes	First
21	Second	Poor	Good	Average	Yes	Average	Yes	First
22	Second	Average	Average	Average	No	Average	Yes	First
23	Second	Average	Average	Good	Yes	Good	Yes	Third
24	Second	Good	Average	Good	No	Good	No	Second
25	Second	Poor	Average	Average	Yes	Poor	No	First
26	Second	Average	Poor	Poor	No	Poor	Yes	First
27	Second	Average	Poor	Good	Yes	Poor	No	First
28	Second	Average	Poor	Good	No	Good	Yes	Second
29	Secon	Good	Averag	Averag	Ye	Averag	Ye	Third

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SNO	OSM	CTM	SEM	CS	PP	ATT	LP	ESM
	d		e	e	s	e	s	
30	Second	Good	Average	Average	Yes	Average	Yes	First
31	Second	Average	Good	Average	Yes	Average	No	Fail
32	Second	Good	Good	Poor	No	Poor	Yes	Second
33	Third	Poor	Poor	Poor	Yes	Poor	No	Second
34	Third	Poor	Good	Average	No	Average	No	Second
35	Third	Poor	Poor	Good	No	Poor	Yes	Second
36	Third	Good	Average	Good	No	Average	Yes	Fail
37	Third	Average	Good	Good	No	Good	No	First
38	Third	Poor	Average	Good	Yes	Good	Yes	First
39	Third	Poor	Average	Poor	Yes	Good	No	Second
40	Third	Good	Average	Average	No	Average	Yes	Fail
41	Third	Good	Average	Average	No	Good	No	Fail
42	Third	Poor	Good	Good	No	Poor	Yes	Third
43	Fail	Poor	Poor	Poor	Yes	Poor	No	Third
44	Fail	Poor	Poor	Poor	Yes	Good	No	Third
45	Fail	Average	Average	Good	No	Average	No	Third
46	Fail	Poor	Good	Average	Yes	Good	Yes	Second
47	Fail	Good	Average	Poor	Yes	Good	Yes	Second
48	Fail	Poor	Poor	Average	No	Average	Yes	First
49	Fail	Poor	Average	Good	Yes	Good	No	Third
50	Fail	Average	Average	Good	Yes	Poor	Yes	Second

The root node can be deducted by calculating gain information from the given student data set. Here by we have to calculate the entropy value first. Dataset S is a set of 50 given values are *15 "First", 19 "second", 9 "third" and 7 "Fail" for the attribute ESM.*

*Entropy = - ((first/n) * (log (first/n))) – ((second/n) * (log (second/n))) – ((third/n) * (log (third/n))) – ((fail/n) * (log (fail/n)))*

*= - ((15/50) * log (15/50))) – ((19/50) * (log (19/50))) – ((9/50) * (log (9/50))) – ((7/50) * (log (7/50)))*

= 1.312

Figure – 1 Input values to attributes from data set

This form (Fig 1) shows the input values of the given data set. From this input values we calculate the values for Entropy, Gain, Split Information and Gain Ratio for each attribute.

Using the Entropy value we are calculating the gain value,

*Gain = Entropy - (Abs (((first)/n) * (log (first/n)))) / Abs (Entropy) * ((First/n) * (log (first/n)))) – (Abs (((second)/n) * (log (second/n)))) / Abs (Entropy) * ((second/n) * (log (second/n)))) – (Abs (((third)/n) * (log (third/n)))) / Abs (Entropy) * ((third/n) * (log (third/n)))) – (Abs (((fail)/n) * (log (fail/n)))) / Abs (Entropy) * ((fail/n) * (log (fail/n))))*

*= 1.312 - (Abs ((15/50) * (log 15/50))) / Abs (1.312) * ((15/50) * (log (15/50))) – (Abs (((19/50) * (log (19/50)))) / Abs (1.312) * ((19/50) * (log (19/50)))) – (Abs ((9/50) * (log (9/50)))) / Abs (1.312)) * ((9/50) * (log (9/50)))) – (Abs ((7/50) * (log (7/50)))) / Abs (1.312) * ((7/50) * (log (7/50))))*

= 0.4980

Attribute selection can be done by calculating Gain Ratio. Before that we must calculate the Split Information.

Split Information = log (gain)

= log (0.4980)

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= 1.645

Using the split value Gain Ratio can be calculated.

Gain Ratio = split information / gain

= 1.645 / 0.4980

= 0.3026

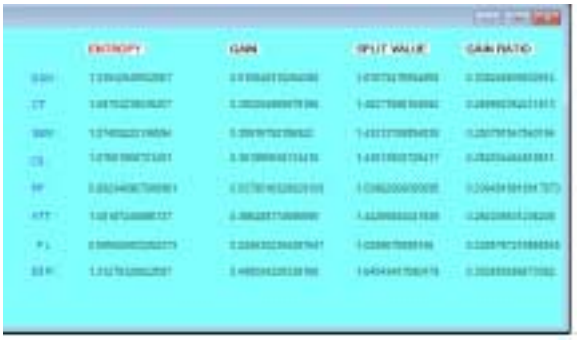
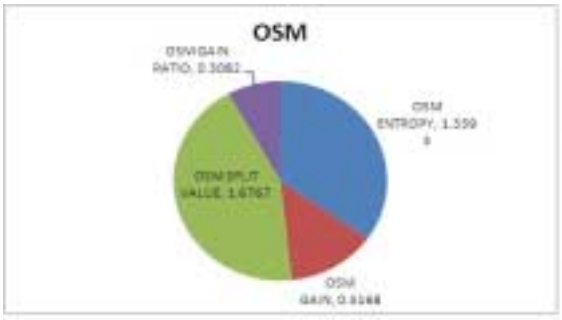


Figure - 2 Output values for given attributes

This Fig 2 shows the calculated value of entropy, gain, split value and gain ratio for the given attributes. The attribute OSM has the maximum gain value, so it is the root node of the decision tree.

These calculations will be continued until all the data classification has been done or else till all the given attributes get over.



5. CONCLUSION

The main concept of this research paper, is to improve the student's performance in an efficient way by using Classification Technique in Data Mining. The concept of Decision Tree which integrates with the classification technique helps to achieve the goal by extracting the discovery of knowledge from the end semester mark. The inclusion of extracurricular activities makes to gain more knowledge along with the End semester Mark. This technique is one of the ways to improve performance of the students in education.

This section will help the teacher to predict those students who have the lesser performance; teacher can develop them with special attention. This study will help these students to improve with confidence.

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