International Journal of Advanced Technology in Engineering and Science
Vol. No.5, Issue No. 02, February 2017
www.ijates.com
ijates
ISSN 2348 - 7550

# ANALYZING STUDENT'S PERFORMANCE USING EDUCATIONAL DATA MINING TECHNIQUES

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**ABSTRACT**

*Educational Institutions play vital role for growth and development of nation and young generation. Nowadays educational data mining is one of the emerging trends which contain various approaches and techniques for analyzing, and predicting the future growth of student's performances. Here one of the highest challenges to improve the educational process by enhancing the student's performance in their academic .In this paper ,educational data mining give some guidelines and prediction to find out the future outcomes of students performances using data sets of students. This system designed by using J48 and REP Tree algorithm which proved to be an efficient algorithm and shows accurate results and also acts as one of the tools for predicting the student's performances.*

**Keywords:** ***Educational Data Mining, Student's Performances, Tools, Algorithms.***

## I INTRODUCTION

The term data mining is frequently used to designate the process of extracting useful information from large databases. Data mining consists of processing large volumes of data about a business's past performance in order to look for patterns that might help predict future performance. It is an intuitive process that allows statistical predictions and creates classifications of data. Most companies already collect and refine massive quantities of data. The knowledge must be new, not obvious, and one must be able to use it. Data collection and storage technology has made it possible for organizations to accumulate huge amounts of data at lower cost. Exploiting this stored data, in order to extract useful and actionable information, is the overall goal of the generic activity termed as data mining.

In this view, the term knowledge discovery in databases (KDD) is used to denote the process of extracting useful knowledge from large data sets. Data mining, by contrast, refers to one particular step in this process. Spherically, the data mining step applies so called data mining techniques to extract patterns from the data. Additionally, it is preceded and followed by other KDD steps, which ensure that the extracted patterns actually correspond to useful knowledge. Indeed, without these additional KDD steps, there is a high risk of finding meaningless or uninteresting patterns [7], [8].

In other words, the KDD process uses data mining techniques along with any required pre- and post-processing to extract high level knowledge from low-level data. In practice, the KDD process is interactive and iterative,

involving numerous steps with many decisions being made by the user [14]. Developing an understanding of the application domain, the relevant background knowledge, Data integration and selection: integration of multiple data sources are the selection of the subset of data that is relevant to the analysis task, application of specific algorithms for extracting patterns from data, Pattern evaluation: interpretation and validation of the discovered patterns are the main activity elements of data mining. That is, to guarantee that actual knowledge is being discovered and Knowledge representation: documenting and using the discovered knowledge are the broad outline of the KDD process.

There are three tiers in the tight-coupling data mining architecture: Data layer can be database and/or data warehouse systems. This layer is an interface for all data sources. Data mining results are stored in data layer so it can be presented to end-user in form of reports or other kind of visualization. Data mining application layer is used to retrieve data from database. Some transformation routine can be performed here to transform data into desired format. Then data is processed using various data mining algorithms. Front-end layer provides intuitive and friendly user interface for end-user to interact with data mining system. Data mining result presented in visualization form to the user in the front-end layer. The tight coupling architectural view of the Data Mining is given in Figure.1. [20]

## II DATA MINING TASK

The main tasks well-suited for data mining is all of which involve extracting meaningful new information from the data. Knowledge discovery (learning from data) comes in two flavors: directed (supervised) and undirected (unsupervised) learning from data. The six main activities of data mining are: *classification* (examining the feature of a newly presented object and assigning it to one of a predefined set of classes); *estimation* (given some input data, coming up with a value for some unknown continuous variable such as income, height, or credit-card balance); *prediction* (the same as classification and estimation except that the records are classified according to some predicted future behavior or estimated future value); *affinity grouping or association rules* (determine which things go together, also known as dependency modeling,

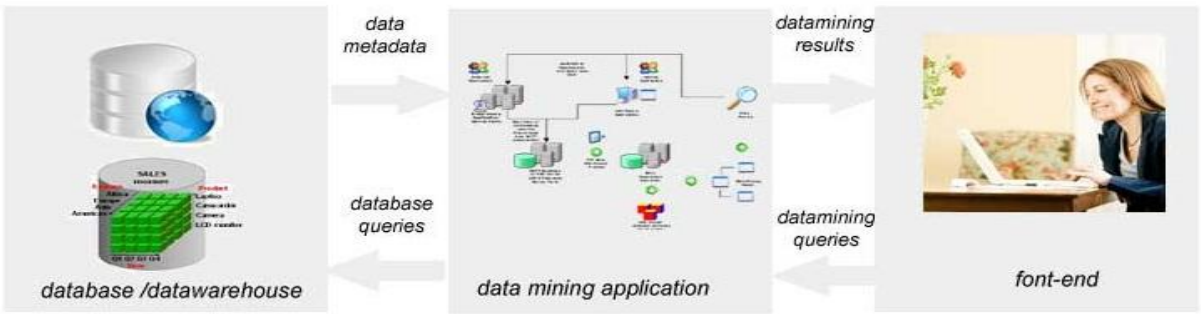



**Figure 1: Architecture of Data mining**

e.g. in a shopping cart at the supermarket - market basket analysis); *clustering* (segmenting a population into a number of subgroups or clusters); and *Description and visualization* (exploratory or visual data mining) The first three tasks classification, estimation and prediction are all examples of directed knowledge discovery (supervised learning). In supervised learning the goal is to use the available data to build a model that describes

one particular variable of interest, such as income or response, in terms of the rest of the available data ("class prediction"). The next three tasks affinity grouping or association rules, clustering, and description and visualization are examples of undirected knowledge discovery (unsupervised learning). Unsupervised learning attempts to find patterns or similarities among groups of records without the use of a particular target field or collection of predefined classes. This is similar to looking for needles in haystacks.

## III METHODS AND MATERIALS

*Schwarz et al.,(2012)* [18] it was demonstrated that data mining techniques can play an important role in rule refinement even if the sample size is limited. For that at first stage methodology is used for exploring and identifying inconsistencies in the existing rules, rather than generating a completely new set of rules. K-mean algorithm lies in the improved visualization capabilities resulting from the two dimensional map of the cluster. Kohonen developed self organizing maps as a way of automatically detecting strong features in large data sets. Self organizing map finds a mapping from the high dimensional input space to low dimensional feature space, so the clusters that form become visible in this reduced dimension ability.

*Brijesh Kumar Baradwaj,et.al,(2014)[4]* presents the classification task to evaluate student's performance. The Decision tree method is used in this work. The information on attendance, class test, seminar and assignment marks were collected from the student database to predict the performance at the end of the semester. It helps to identify the dropouts' students. Special attention can reduce fuel ration and taking appropriate action for the successive semester examination. The data set from VBS purvanchal university, Jaunpur has been used in this paper. The sampling data set of computer Application department, of course in MCA from 2007 to 2010 was taken for analysis. The sample 50 data set were considered.

*Saurabh Pal, et.al,(2011[5]* conducted as study on student academic performance of the Dr. R.M.L. Awadh University, Faizabad by selecting 300 (226 males, 74 females) students of BCA course from five colleges in the 2010 examination. The Bayesian Classification method is used to predict the students' performance to identify the difference between high learners and slow learners student by help the teachers to improve the student performance .

*R. R. Kabra, et.al( 2011*), [10] conducted a study on student academic performance at S.G.R. Education Foundation's College of Engineering and Management. The sampling data are taken for first year engineering in the year 2009-10 and 2010-11. The Classification technique and decision tree algorithms are applied to engineering students past performance data and predicted the student's performance. The confusion matrix is generated and analyzed to identify the students fail records. The accuracy of the model improves their attributes for better performance.

*SajadinSembiring, et.al,(2011)* [16] presents the dataset of the University Malaysia Pahang, the sample data for 1000 records in the different major students are considered. SSVM Classification algorithm is implemented to predict the students' final grade and Cluster technique is used to group the students using kernel k-means clustering. The correlation between psychological condition of student behavior and their final academic performance are carried out in this work. This type of technique is used in higher education in particular the psychometric variables predictors.

*Sonali Agarwal,et.al,(2012)* [17] analyzes the student data from a community college database. The dataset has 2000 student details.SVM, LIBSVM, RBF Network, Multilayer Perception, SMO are the 8 different classifiers used in this work. The SVM is the best classifier with maximum accuracy and minimum root mean square error (RMSE).

*Dr. A. Padmapriya, et.al,( 2012)* [15] given the data for 690 under-graduate students from Government arts college (W), Pudukkottai. This study focused on the development of data mining models for predicting the students higher studies based on their personal, precollege and graduate performance. The comparisons of Decision tree algorithm and Naive Bayesian Classifier algorithm are carefully pre-processed student data and reveal the classification accuracy result.

*Azhar Rauf, et.al,( 2012*)[3] conducted a survey and the Cluster technique, Enhanced K-mean algorithm is implement the basic K-mean algorithm is compared with Enhanced K-mean clustering algorithm. The Enhanced K-mean Clustering calculates initial centroid points of randomly selected data. The numbers of iterations are reduced and elapsed time is improved.

*Mohammed M. Abu Tair, et.al,( 2012)* [13] used the data set from the college of Science and Technology in Khanyounis for fifteen year period of 1993-2007. 3360 graduate student sample records are used. The preprocess data is applied for various techniques like association, classification, clustering and outlier detection rules. This research paper study improves the performances of graduate students.

*MrinalPandey, et.al,(2013)* [14] conducted a study on student academic performance of Manav Rachna College of engineering district Faridabad of Haryana, are considered of 524 student data records. In this study, Classification task are decision tree to predict performance of students, particularly for engineering branches of BTech student data base. The cross validation method is used to evaluate efficiency of the different algorithm. This model helps to the management to identify the weak students to prevent them failure.

*Swasti Singhal, et.al,(2013)* [18]conducted a study on student academic performance, the raw dataset was collected. This research work uses the techniques of preprocessing, Classification and Clustering to improve student performance.

*Leila Dadkhahan, et.al,(2013)* [12] conducted a survey on the data set of American College Testing (ACT). The University of Kentucky reported statistics for first-year full-time students' performance over six year course. Classification and prediction are the interesting techniques used to apply the models to identify student at risks to predict their academic performance. As a result, students' academic performance improved and leaded to increase student retention and graduation rate for institutions.

*Ajay Kumar Pal, et.al,( 2013) [2]* uses the data from different degree colleges and institutions in Dr. R. M. L. Awadh University, Faizabad. The data set used from the different colleges on the sampling course for Bachelors of Science in 2011-12. Initially the size of data is 200.Various classification techniques are applied in decision tree, nearest neighbor and neural network. Accurate predictive performance on the student record is to identify the students who needed special attention .

*Komal S. Sahedani, et.al,( 2013)* [11] use the data set from Community colleges and universities to predict with a high degree of accuracy. Classification method and feature selection techniques are be used in student dataset. By acting on these predictive models used in the educational institutions can effectively address the issues ranging from transfers and retention.

*M. Durairaj, et.al,( 2014)* [6] presents the data set of 300 student records, and then chosen sample of 38 data used it. Classifications methods compare and predict the pass percentage and fail percentage and absent details have produced an accurate measure in the confusion matrix method used for WEKA tool implementation.

*Seaman,et.al,( 2014)* [19] Collected the information about admission details and personal details. The clustering techniques are used to compare the data for k-mean, and OPTICS and Classification techniques, comparisons are Bays net, naive net and decision tree.

*Abeer Badr El Din Ahmed,et.al,(2014)* [1]conducted a study on the student performance by selecting a sample of 300 students (225 males, 75 females) from a group of colleges affiliated to Punjab university of Pakistan. The hypothesis that was stated as Student's attitude towards attendance in class, hours spent in study on daily basis after college, students' family income, students' mother's age and mother's education are significantly related with student performance" was framed. By means of simple linear regression analysis, it was found that the factors like mother's education and student's family income were highly interconnected with the student academic performance. Table 1: Comparison of literature survey for Data mining Research Trends in various techniques and tools, Challenges to find the most problem to analysis .

**Data mining in education**: Educational data mining (EDM) is an area that uses statistical techniques, machine learning and data mining to analyze educational data. Thanks to the use of these techniques, it is possible to improve the teaching/learning processes involving students and instructors Educational data are complex and come in many different formats, which require the use of special data interpretation and processing techniques. Data mining has proved to be very useful in this context. Juan A. Lara et.al [9]. Proposes the use of knowledge discovery in databases (KDD) to extract knowledge that teachers are likely to find useful by analyzing data generated by the interaction of students with e-learning environments, like Modal for example. To do this, the proposal is able to build historical reference models of students that dropped out of and students that completed the course. These generated models can be used to classify a specific student within the dropout or non- dropout group. The proposal has been evaluated on real academic data for students enrolled in several courses. The system then analyses the participative data of each student in the virtual classroom, which it compares with each of the generated reference models. The proposed knowledge discovery system classifies students analyzing the temporal information that reflects the time at which patterns emerge. The use of this temporal information is one of the novelties that the proposed system includes compared with other proposals that propose classification techniques based on non-temporal data, thereby omitting a large amount of useful information [9].

## IV EDUCATIONAL DATA MINING ALGORITHM AND TECHNIQUES

### 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.

### 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.

### C. Predication

Regression technique can be adapted for predication. 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.

| *AUTHOUR NAME* | *METHODS* | *TECHNIQUES* | *TOOLS* | *FINDING* |
|---|---|---|---|---|
| M. Durairaj, et, al. | Cluster | K-mean cluster and Naive Bays cluster | WEKA Tool | Accurate Measures is Pass, Fail and Absent |
| Dr. A. Padmapriya | Classification | Decision tree and Naive Bayesian classifier | WEKA Tool | Naive Bayesian overcomes to Decision tree |
| Saladin Sembiring, et,al. | Classification and Cluster | SSVM Classification and Kernel k-means Clustering | Rapid Miner | The quality of student performance |
| R. R. Kabra, et, al. | Classification | ID3 Tree classification | WEKA Tool | Lower grade student are identified |
| Mrinal Pandey,et,al. | Classification | J48,NBtree,Reptree Classification | WEKA Tool | To perform Final grade and student performance |
| Brijesh Kumar Bhardwaj, et,al. | Classification | Naive Bays classification | Matlab | Slow learners are identified |
| Sonali Agarwal,et,al | Classification | Logistic, Multilayer perceptron, Winnow | WEKA Tool | The result of quality performance |
| Srecko Natek,et,al | Classification | Reptree,J48and M5P Classification | WEKA Tool | The efficiency of M5p algorithm |
| Azhar Rauf,et,al | Cluster | Proposed K-mean cluster and Basic K-mean cluster | Matlab | The number of iterations is reduced time is improved. |
| AjayKumar Pal,et,al | Classification | Nearest neighbors, Neural networks and Decision tree | WEKA Tool | To identify the weak students |

**Table 1: Data mining Research Trends in various techniques and tools, Challenges to find the most problem to analysis**

### 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).

## V EXPERIMENTAL WORK

In Educational Data mining system, Students performance was analyzed by their academic details such as Attendance, $10^{th}$, 12th and semester marks which predict the student's performance for future growth.

### A. Data Preparations

The data set used in this study was obtained from G.Venkatasamy Naidu College, Kovilpatti (Tamil Nadu) on the sampling method of Information Technology department of Information Technology from session 2013 to 2016. Initially size of the data is 100. Among the dataset around 50 are been used as training dataset and 50 datasets as test data to design student model.

### B. Data Selection and Transformation

In this section the data required for educational data mining are selected. A few fields were selected. From the available database, some of the information for the fields is collected. The data collected from Feedback forms and database .initially attribute selection is done. In this step only those fields were selected which were required for data mining. The process of attribute selection deals with selecting the most appropriate attributes for classifying the data sets. By the analysis among the 12 attributes, attributes of higher ranking are used for classifying the training dataset.

| student n | gender | roll numb | area | 10 th mar | 12-Mar | medium | attenden | class test | assignme | 1 sem | 2 sem | 3sem | 4 sem | 5sem |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| s.abinaya | female | 15201 | rural | 450 | 1020 | metriculat | best | excellent | Yes | 88 | 85 | 86 | 81 | 84 |
| .rama | female | 15202 | urban | 400 | 850 | state boar | good | medium | Yes | 75 | 78 | 74 | 77 | 78 |
| s.avitha | female | 15203 | rural | 350 | 750 | metriculat | good | medium | Yes | 70 | 70 | 72 | 72 | 73 |
| p.rama | female | 15204 | rural | 300 | 700 | state boar | average | medium | Yes | 68 | 71 | 70 | 71 | 74 |
| r.revathi | female | 15205 | rural | 270 | 650 | state boar | poor | bad | no | 63 | 65 | 68 | 70 | 71 |
| r.sudha | female | 15206 | urban | 345 | 778 | metriculat | good | medium | Yes | 72 | 75 | 77 | 79 | 80 |
| m.mahesv | female | 15207 | urban | 451 | 1002 | state boar | best | excellent | Yes | 82 | 83 | 84 | 83 | 86 |
| p.rishnave | female | 15208 | urban | 463 | 989 | state boar | best | excellent | Yes | 80 | 77 | 82 | 84 | 86 |
| r.rathama | female | 15209 | urban | 357 | 790 | metriculat | good | medium | Yes | 73 | 71 | 75 | 79 | 80 |
| a.arthi | female | 15210 | rural | 278 | 650 | metriculat | average | medium | Yes | 63 | 66 | 69 | 69 | 71 |
| s.sundari | female | 15211 | rural | 432 | 879 | state boar | good | excellent | Yes | 77 | 78 | 74 | 76 | 77 |
| s.suguna | female | 15212 | urban | 489 | 1030 | state boar | best | excellent | Yes | 92 | 90 | 89 | 90 | 93 |
| v.bharathi | female | 15213 | urban | 367 | 800 | state boar | good | medium | Yes | 71 | 74 | 70 | 71 | 73 |
| d.sinthuja | female | 15214 | rural | 300 | 700 | metriculat | good | medium | Yes | 69 | 70 | 65 | 68 | 70 |
| r.mala | female | 15215 | rural | 321 | 735 | state boar | good | medium | Yes | 67 | 71 | 66 | 67 | 69 |
| s.pathima | female | 15216 | urban | 273 | 690 | state boar | average | bad | no | 68 | 75 | 72 | 72 | 75 |
| r.rajeshwa | female | 15217 | rural | 270 | 80 | state boar | good | medium | Yes | 65 | 68 | 70 | 73 | 72 |
| p.manima | female | 15218 | urban | 345 | 740 | metriculat | good | medium | Yes | 69 | 72 | 74 | 72 | 70 |
| e.sumathi | female | 15219 | rural | 489 | 920 | metriculat | best | excellent | Yes | 80 | 78 | 79 | 80 | 81 |
| r.ramani | female | 15220 | urban | 435 | 900 | state boar | best | excellent | Yes | 80 | 79 | 81 | 83 | 82 |

Average: 42806 Count: 17 Sum: 42806 120%

**Figure 2: Collection of datasets**

### C. WEKA Tool Preprocessor

WEKA is a machine learning state of art data mining technique. WEKA is a collection of machine learning algorithms for data mining tasks. The algorithms can either be applied directly to a dataset or called from our own Java code. WEKA is software. Figure 3 shows the first page of WEKA.

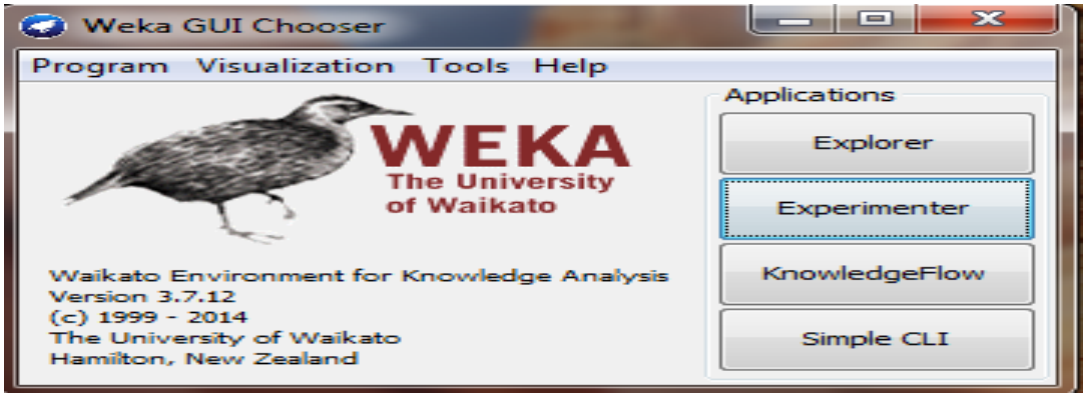



**Figure 3: WEKA Page**

The preprocessed data set is shown in Figure 4 Student roll number, department, course studying, marks and other related, in total 100 attributes are preprocessed for this study and analysis work. The result shows based on the instance of the attributes. The attributes in this database are displayed in the row format and the bar graph represents the distributions of the different attributes that are considered for data mining. All the attributes are preprocessed and visualized in the screen.

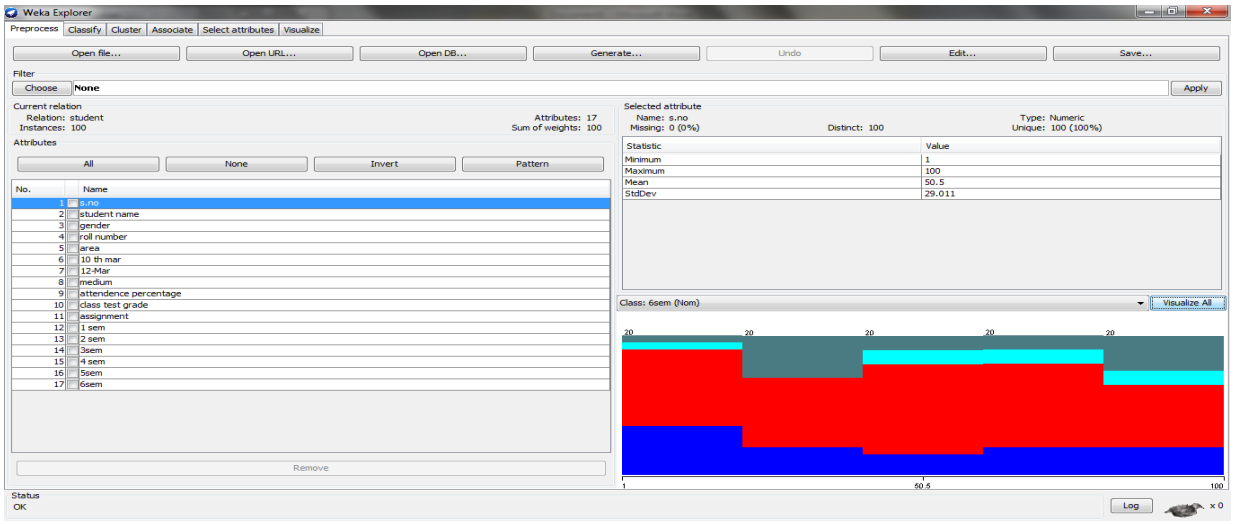
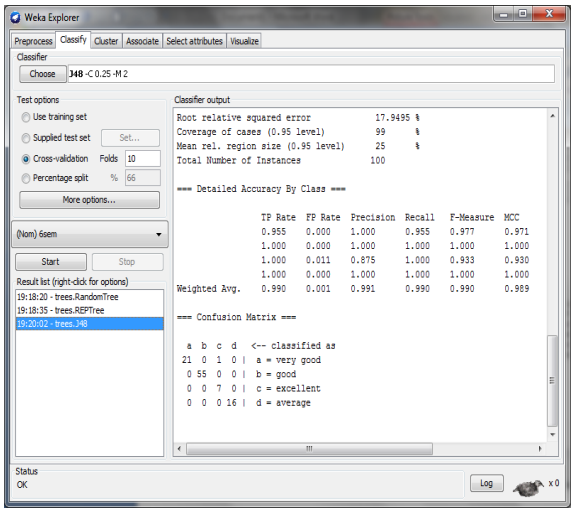



**Figure 4: Preprocess using WEKA Tool**

### D. Decision Tree Algorithm

The decision tree used in WEKA is termed as J48 which is a modification of the C4.5 algorithm and REP Tree algorithm. Decision tree algorithm performed for selected particular attribute to compare for Classification of data and the confusion matrix will be displayed in the classifier output screen below the decision tree as shown in Figure 5.A: J48 Tree Classified Rule and Figure 6.A : REP Tree Classified Rule. Once the rules are extracted, the decision tree is created based on the rules and the association between the attributes. The decision tree with respect to student performances research is shown in Figure 5.B performed J48 Tree, Figure 6.B: performed REP Tree. Classification on the test data is done based on the decision tree that is created. The compare is

classified for J48 Tree and REP Tree algorithm performed for J48 Tree algorithm is better than best accuracy of REP Tree algorithm.



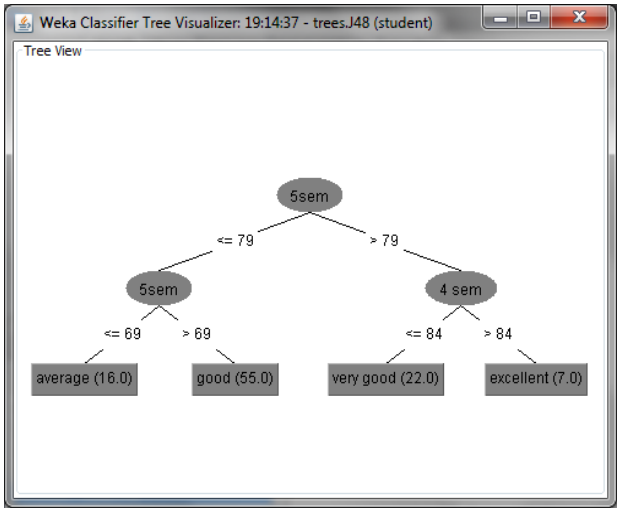
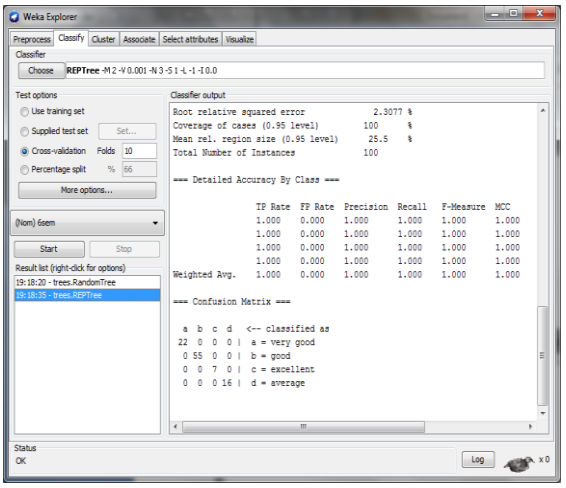




**Figure 5.A: J48 Tree Classified Rule** **Figure 5.B:J48 pruned Tree**

The pruned Tree constructed from the classifier output of the tool is shown in Figure 5.B. The tree is constructed based on different 16 nodes based on the classifier output. The student performances in Under Graduation are analyzed based on SSLC and Higher secondary mark scores. From the tree it is under stands that only 3 attributes are required to create the tree, which means the rest six attributes (Grade) are not used to classify the dataset.



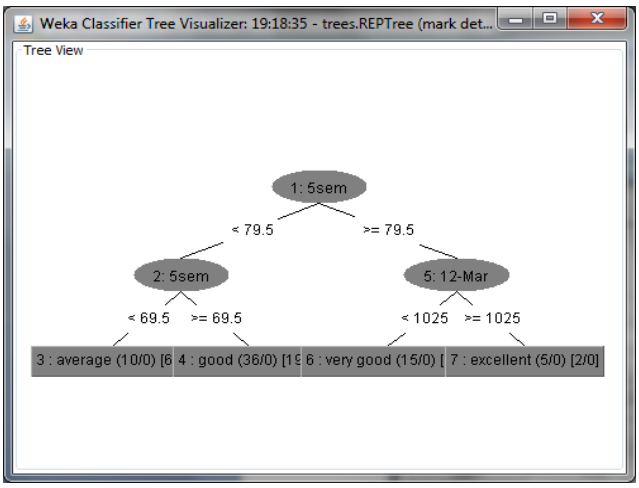




**Figure 6.A: REP Tree Classified Rule Figure 6.B: REP Tree Classifier output**

## VI CONCLUSION

In this paper, Student's performance was predicted by classification method. Here J48 and REF tree algorithm were used for classification of student performances. Information likes student 10th, 12th and 1 to 5th semester mark statement were collected from pervious student's database. This study will help many educational

institutions to improve the student's carrier for future and also give the details about the student's performance for the next semester examination.

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