Comparative Analysis of Classification Algorithms using WEKA

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ABSTRACT

Data Mining is the process of drawing out the useful information from the raw data that is present in various forms. Data Mining is defined as study of the Knowledge Discovery in database process or KDD. Data mining techniques are relevant for drawing out the useful information from the huge amount of raw data that is present in various forms. In this research work different types of classification algorithms accuracies are calculated which are widely used to draw the significant amount of data from the huge amount of raw data. Comparative analysis of different Classification Algorithms have been done using various criteria's like accuracy, execution time (in seconds) and how much instances are correctly classified or not classified correctly.

KEYWORDS: Data Mining, J48, Random Tree, Naïve Bayes, Multilayer Perceptron, WEKA

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I. INTRODUCTION

Data Mining is the process of exploring the patterns with the help of various techniques in the data gathered from the various sources [1]. Data Mining also involves selection of the relevant data from the database, preprocessing of the relevant data, transformation in the suitable form, data mining and evaluation of the data and afterwards online updating and visualization [1]. It is the analysis step of the "Knowledge Discovery" process. The actual task of the Data Mining is semi-self-regulating or self-regulating investigation of the large batches of the dataset for extracting the previously unknown, unusual records and dependencies [1]. Knowledge Discovery process includes various selection steps which helps in the efficient extraction of the useful data from the large datasets. These steps are sequential steps and they are repeated in iterative sequential manner until the useful information is not extracted. Data Mining is one of the essential steps in the KDD process [2].

Step 1: Selection Step: In the first step suitable data for the investigation task is fetched from the database [3]. On the basis of the extraction of suitable data objective dataset is formed [2].

Step 2: Pre-Processing Step: In the second step the data which is collected in the selection step is highly concerned with problems like vagueness, missing and irrelevant data due to magnificent size and complexity. The above concerned problems are molded into a form which is suitable for the data mining techniques with the help of the different tools used for the data mining [2].

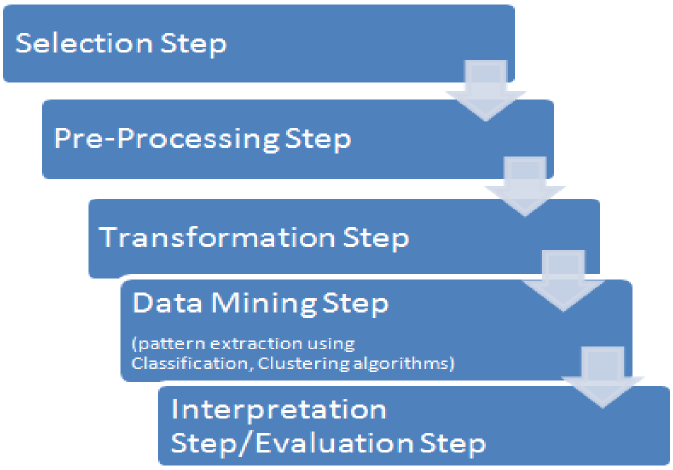

Selection Step
Pre-Processing Step
Transformation Step
Data Mining Step
(pattern extraction using Classification, Clustering algorithms)
Interpretation Step/Evaluation Step

Figure 1: Sequential Steps of KDD Process

Step 3: Transformation Step: In the third step data is molded into the form which is suitable for the classification by performing different operations like accumulation, induction, normalization, discretization and construction operations for the features [2] [3]. WEKA tool is used for the research work.

Step 4: Data Mining: In the fourth step the Data Mining techniques (algorithms) are used for drawing out figures. Data Mining is used to analyze the dataset [2] [3]. In this work Data Mining Classification algorithms like J48, Random Tree, Naïve Bayes, and Multilayer Perceptron are used for the investigation using WEKA Machine Learning Tool.

Step 5: Interpretation/ Evaluation Step: In this step data patterns are identified on the basis of the some measures. To figure out and interpret the mining results correctly users need visualization approach to work with[2].

II. RELATED WORK

K. Ahmed, T. Jesmin, 2014, this paper proposes to analyze accuracy of the data mining algorithms using three testing beds which are Percentage Split method, Training Data Set method and Cross Validation method. The classification is performed on type-2 Diabetes disease dataset. According to this research paper the top 5 algorithms for classifying diabetes patients are Bagging (accuracy 85%), Logistic and Multiclass Classifier(accuracy 81.82%) [4].

C. Anuradha, T. Velmurugan, 2015, this paper comes up with the prediction of the future outcome of the final year results of UG student's dataset. Cross fold validation and percentage split are the two testing beds used in the classification. According to the research Naïve Bayes and Bayes Net performs well for the data set taken and K-NN, OneR performs poorly [5].

S. Gupta, N. Verma, 2014, proposes to analyze the classification algorithms on the basis of the Mean Absolute Error, Root Mean Squared Error and the Confusion Matrix. The performance evaluation is being done on the Naïve Bayes classifier and according to the research the Mean Absolute Error and the Root Mean Squared Error is less in case of the training data set. According to the evaluated results Naïve Bayes comes out to be the best suited algorithm [6].

R. Sharma et al, 2015, worked with various data mining algorithms to comparatively analyze those using criteria's like definitiveness, execution time, different datasets and their applications. The algorithms which have been compared in the research are M5P algorithm, K Star algorithm, M5 Rule algorithm, Multilayer Perceptron algorithm. For the large dataset K-star comes out with the highest definitiveness. [7].

N. Orsu et al, 2013, stated about the different classification algorithms and their comparisons on micro-array of data that helps in predicting the occurrence of the tumor. Authors have compared 14 different classification algorithms on the basis of the accuracy. According to the research work all classifiers comes out with the significant performances in terms of accuracies [8].

S. Khare, S. Kashyap, 2015, provided analysis of the different classification algorithms which includes decision tree, bayesian network, k-nearest neighbor classifiers and artificial neural networks. A brief description of data mining and classification is given in the paper. Voting Dataset is used for analysis. According to the research work decision tree accuracy is better than the other algorithms [9].

Md. N. Amin, Md. A. Habib, 2015, worked on the comparative analysis of J48 decision tree, multilayer perception, and naïve bayes. According to the authors the research work shows the best algorithm is J48 with an accuracy of 97.61%, and the algorithm which is having lowest error rate with 27.91% is Naïve Bayes [10].

S. Carl et al, 2016, worked on the comparative analysis of data mining algorithms which are k-means algorithms, k nearest neighbor algorithm, decision tree algorithm, naïve bayes algorithm. From the research performed by the authors they have found that k means algorithm have less error rate and is the easier algorithmas compared to the KNN and Bayesian [11].

S. Vijayarani, M. Muthulakshmi, 2013, worked on the performance analysis of the bayesian and lazy algorithms. Various performance factors like ROC area, Kappa Statistics, TP Rate etc are used for the analysis. From the comparison it can be concluded that Lazy classifiers is efficient than the Bayesian classifiers [12].

S. Nikam, 2015, worked on the comparative analysis of classification algorithm like C4.5, ID3, k- nearest neighbor, Naïve Bayes, SVM and ANN. Each algorithm has its limitations and features and based on theconditions we can choose the best suited algorithm for our dataset [13].

G. Raj et al, 2018, has shown comparative analysis of the classification algorithms using WEKA on hematological data of diabetic patients. The algorithms which have been studied are J48 decision tree, Zero R, Naïve Bayes. From this comparison it can be concluded that Naïve Bayes is the best algorithm on diabetic data with 76.3021% accuracy.

Naïve Bayes classifier can be used to enhance the traditional classification methods which are used in the medical or bioinformatics areas [14].

N. Jagtap et al, 2017, provided a comprehensive analysis of different classification algorithms like Support Vector Machines, Bayesian Networks, Genetic Algorithms, Fuzzy Logic etc. The comparative study of the algorithms is done on the basis of the advantages and disadvantages of the algorithms [15].

N. Nithya et al, 2014, stated about the Logistics, Simple Logistics, SMO algorithms which are compared on the basis of the accuracy measurement, TP Rate, FP Rate, Precision, Kappa Statistics etc. According to the analysis Logistics method suits best from the Function Classifier Algorithm, but according to the time accuracy SMO produces the best result [16].

S. Chiranjibi, 2015, worked on the comparative analysis of Naïve Bayes, Bayes Network, Logistics, Decision tree, Multilayer Perception, REPTree, ZeroR, Ada Boost. From the work it can be concluded that logistic algorithm is best which works well for the higher no of attributes and higher no of instances [17].

C. Fernandes et al, 2017, describes about the different decision tree classifiers and the decision tree classifiers are used to forecast student's proficiency. CHAID has highest accuracy rate that is 76.11%followed by C4.5 by 73.13% [18].

S. Srivastava et al, 2013, worked on the performance of classification algorithms and results are compared and evaluation is done on the already existing datasets. Accuracy of the SPRINT algorithm is more and the performance is satisfactorily good [19].

A. Lohani et al, 2016, worked on the comparative analysis of the algorithms and the result of the analysis is shown using ROC (Receiver Operating System) graphically. This paper shows that if ensemble methods are used than better results can be seen. C4.5 algorithm is not stable [20].

S. Devi, M. Sunadaram, 2016, stated about the data mining and the various research domains, about meta and tree classifiers. This paper provides analysis between meta and tree classifiers and as a result of the analysis it is shown that meta classifier is more efficient than tree classifier [21].

S. Priya, M. Venila, 2017, stated about the cancer diagnosis which is a field of healthcare and the diagnosis of the disease is done with the help of the data mining classification algorithms on the basis of the correctly and incorrectly classified instances [22].

K. Danjuma, A. Osofisan, 2014, stated about various classification algorithms and they have been comparatively analyzed using cross-fold validation method and sets of performance metrics. The analysis shows that 97.4% accuracy was of Naïve Bayes, Multilayer Perceptron having 96.6% and J48 comes with much less accuracy that is 93.5% [23].

N. Kaur, N. Dokania, 2018, worked on the comparative analysis of k-mean and y-mean done on the basis of the features like efficiency, number of clusters an item belongs, performance, shape of cluster, detectionrate etc.[24].

E. Sondakh, R. Pungus, 2017, worked on the comparative analysis of three classification algorithms tocompose the best suited algorithm for model. Three algorithms resulting models shows no significant difference between performance of Naïve Bayes and Decision Tree while SVM shows lowest performance [25].

K. Kishore, M. Reddy, 2017, stated about data mining and its different techniques. Two things have been explained one the comparison between different datasets using one algorithm and second comparison of different algorithms using single dataset [26].

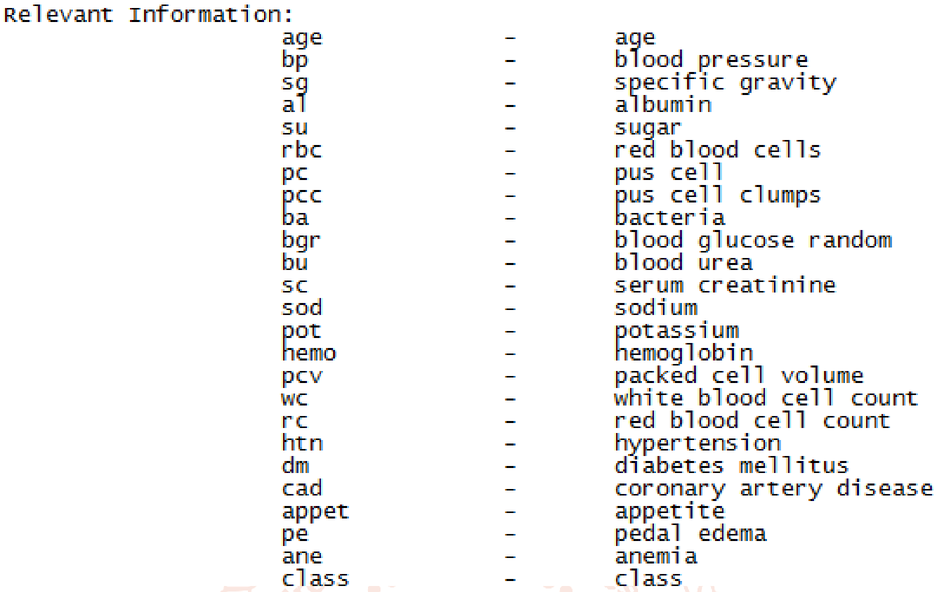
III. RESEARCH METHODOLOGY

In data mining classification of large data set is a problem. Data mining has various techniques like classification, regression, clustering etc. This paper mainly focuses on the classification techniques having various algorithms which will help in classifying the records. The datasets contains instances or the classes and the attributes which helps in classifying the records. Random Tree, J48 Decision Tree, Multilayer Perceptron and Naïve Bayes are the algorithms used for the analysis of the classification techniques.

The research work mainly focuses on the comparative analysis of the classification algorithms which are Naïve Bayes, Multilayer Perceptron, Random Tree and J48 on Chronic Kidney Disease dataset. The results of comparative analysis are anatomized to deduce best suited algorithm on the basis of definitiveness, execution time, correctly classified instances and incorrectly classified instances.

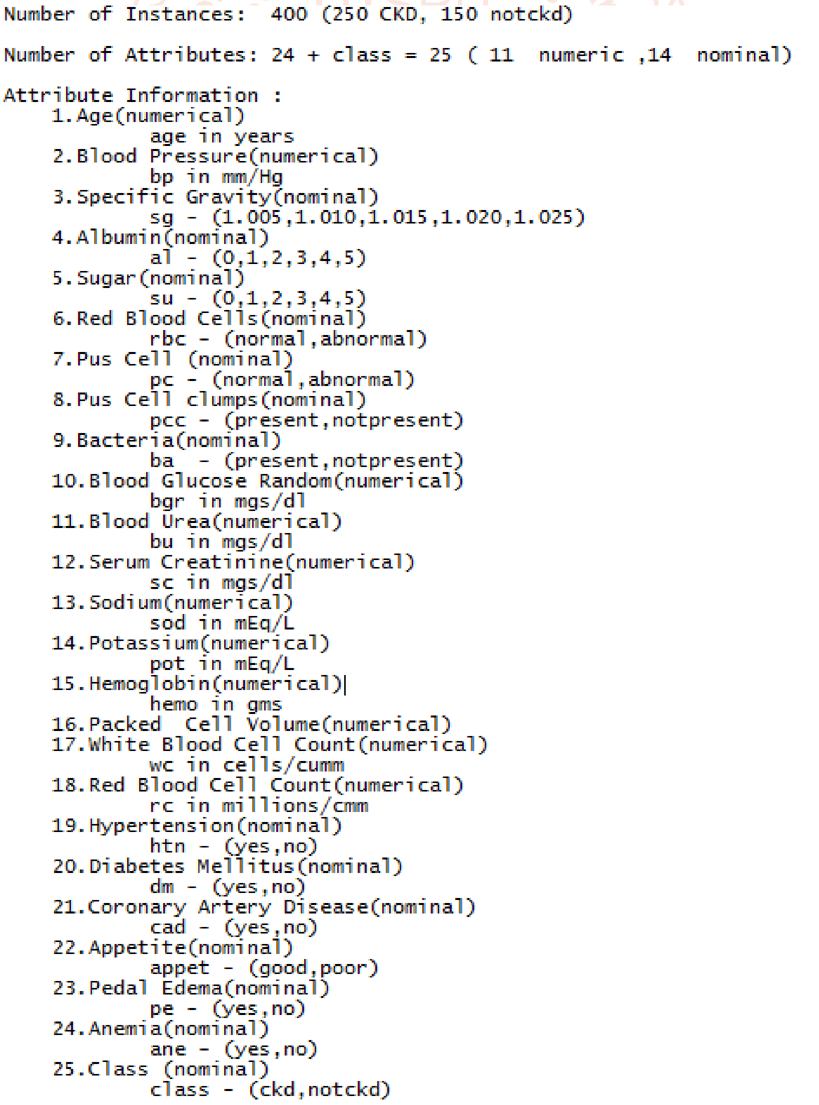
A. **DATASET USED:** In this research work we have used Chronic Kidney Disease (CKD) dataset. The main focus of this reasearch is performance and evaluation of Naïve Bayes, Multilayer Perceptron, J48, Random Tree algorithms. This dataset contains 400 instances and 25 attributes. For analyzing the performance of the classification algorithms WEKA data mining tool is used.

Chronic Kidney Disease is a type of disease in which kidney losses its function over a period of month or year. Clinical Diagnosis of the Chronic Kidney Disease is done with the help of urine and the samples of the blood as well diagnosing the sample of the kidney tissue. Early diagnosis and detection of the disease is very important so that failure of the kidney can be stopped. For predicting chronic kidney disease data mining and analytics techniques are used and historical patient's data and diagnosis records are used. Using the CKD dataset comparative analysis of the algorithms is done on the basis of parameters accuracy, properly graded instances, improperly graded instances, error rate and execution time [28].



```
Relevant Information:
                      age         -     age
                      bp          -     blood pressure
                      sg          -     specific gravity
                      al          -     albumin
                      su          -     sugar
                      rbc         -     red blood cells
                      pc          -     pus cell
                      pcc         -     pus cell clumps
                      ba          -     bacteria
                      bgr         -     blood glucose random
                      bu          -     blood urea
                      sc          -     serum creatinine
                      sod         -     sodium
                      pot         -     potassium
                      hemo        -     hemoglobin
                      pcv         -     packed cell volume
                      wc          -     white blood cell count
                      rc          -     red blood cell count
                      htn         -     hypertension
                      dm          -     diabetes mellitus
                      cad         -     coronary artery disease
                      appet       -     appetite
                      pe          -     pedal edema
                      ane         -     anemia
                      class       -     class
```

Figure 2: Abbreviations used in dataset



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Number of Instances:  400 (250 CKD, 150 notckd)

Number of Attributes: 24 + class = 25 ( 11  numeric ,14  nominal)

Attribute Information :
    1.Age(numerical)
            age in years
    2.Blood Pressure(numerical)
            bp in mm/Hg
    3.Specific Gravity(nominal)
            sg - (1.005,1.010,1.015,1.020,1.025)
    4.Albumin(nominal)
            al - (0,1,2,3,4,5)
    5.Sugar(nominal)
            su - (0,1,2,3,4,5)
    6.Red Blood Cells(nominal)
            rbc - (normal,abnormal)
    7.Pus Cell (nominal)
            pc - (normal,abnormal)
    8.Pus Cell clumps(nominal)
            pcc - (present,notpresent)
    9.Bacteria(nominal)
            ba  - (present,notpresent)
    10.Blood Glucose Random(numerical)
            bgr in mgs/dl
    11.Blood Urea(numerical)
            bu in mgs/dl
    12.Serum Creatinine(numerical)
            sc in mgs/dl
    13.Sodium(numerical)
            sod in mEq/L
    14.Potassium(numerical)
            pot in mEq/L
    15.Hemoglobin(numerical)|
            hemo in gms
    16.Packed  Cell Volume(numerical)
    17.White Blood Cell Count(numerical)
            wc in cells/cumm
    18.Red Blood Cell Count(numerical)
            rc in millions/cmm
    19.Hypertension(nominal)
            htn - (yes,no)
    20.Diabetes Mellitus(nominal)
            dm - (yes,no)
    21.Coronary Artery Disease(nominal)
            cad - (yes,no)
    22.Appetite(nominal)
            appet - (good,poor)
    23.Pedal Edema(nominal)
            pe - (yes,no)
    24.Anemia(nominal)
            ane - (yes,no)
    25.Class (nominal)
            class - (ckd,notckd)
```

Figure 3: Instances and Attributes in Dataset

B. CLASSIFICATION: Classification is a data mining technique and is a supervised learning having broad applications. Classification technique classifies each item of a set into a predefined set of classes or groups. Among all the techniques in the data mining the apex technique is classification. Dataset is being inspected by classification and each instance of the dataset is considered. The instances which are inspected and considered by the technique are appointed to appropriate class such that there will be least error in the model [29].

Models defining the influential data classes inlying in a particular dataset are withdrawn using classification technique. The two states of the classification includes application of the algorithm to construct the model and afterwards constructed model is tested contrary to a already defined dataset to measure the performance and definitiveness(accuracy) of the model. In this research work we have analyzed Naïve Bayes, Random Tree, J48 and Multilayer Perceptron algorithms on Chronic Kidney Disease dataset. Above algorithms are briefly described below:

NAÏVE BAYES: Naive Bayes is one of the classifier algorithms in data mining under the bayes class or it can be said that it is an enhanced form of bayes theorem. The possible result is calculated according to the input in Bayesian classifier. Those features of class are considered by the naïve bayes which are not related to any other feature of the class [29]. Working of naïve bayes algorithm is described as follows:

- P (d|b) → Posterior probability of class (target) given predictor (attribute) of class.
- P(d) → Prior probability of class.

$$p(d|b) = \frac{p(b|d) \times p(d)}{p(b)}$$

$$\boldsymbol{p(b|d) = p(b1|d) * p(b2|d) * p(b3|d) * \ldots \ldots \ldots \ldots * p(bn|d) * p(d)}$$

Figure 4: Naïve Bayes Theorem [30]

- P (b|d) → likelihood which is the probability of predictor of given class.
- P(b) → Prior probability of predictor of class.

J48: J48 classifier is the enhanced version of the C4.5 classifier. Decision tree is produced as a resultby the J48. Decision tree produces a tree like structure which has different nodes in it. These different nodes in the tree contain some judgment and each judgment leads to the particular outcome known as decision tree [10]. Simple algorithm is being followed by the J48 which works as follows:

New items are being classified by constructing a decision tree which uses available training datasets values after that those attributes are identified who segregates the distinct instances most clearly [30]. Due to this highest information from the data instances can be gained [30]. Dataset is partitioned into commonly restricted areas where each area has its own tag, values and associated actions to describe its data points. This partitioning helps in deciding which portion of the tree is reaching to a particular resulting node [10].

MULTILAYER PERCEPTRON: Linearly separable problems can be classified by the single layer perceptron. We use more than one or multiple layers for the non-separable problems. For this we use multilayer network. The Multilayer (feed forward) network has multiple layers including multiple hidden layers containing neurons and these neurons are hidden neurons. By using the past data input is correctly mapped into the output when desired output is not known. With each input the output of the neural network is compared with the desired output so as to compute the error [10]. For computing the error output produces by the neural network is compared with the desirable output [10].

Figure of the multilayer network is shown below:

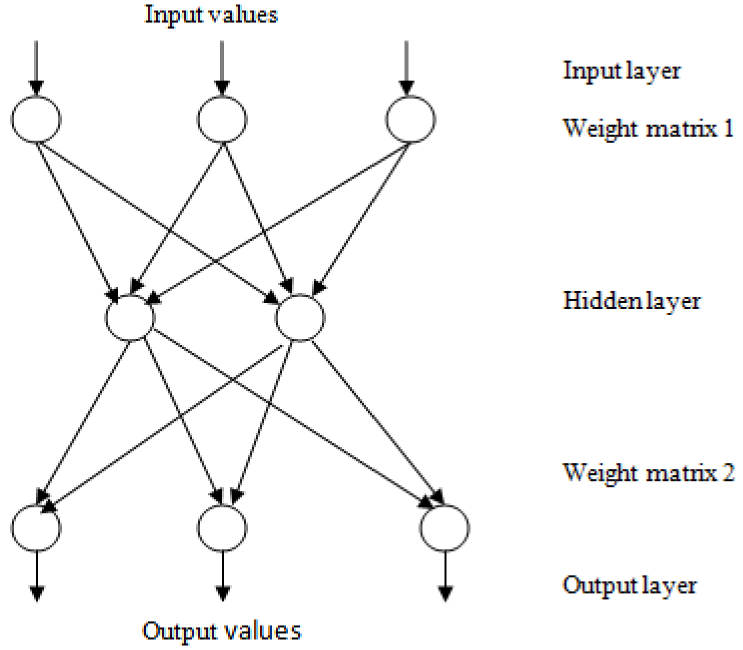


Figure 5: Multilayer Perceptron

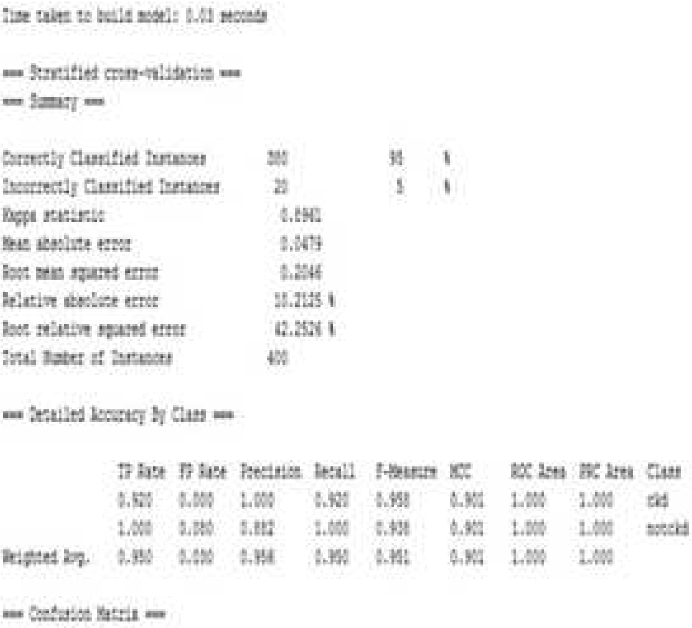
RANDOM TREE: Random Tree is a type of supervised learning algorithm. This learning algorithm produces various trainees. Random Trees have been introduced by the Leio Brieman and Adele Cutler. Randomtree is a group of tree predictors which is known as forest. The random tree algorithm is as follows: random treeclassifier get its input feature vector, this input vector is compared with each tree in the forest and gives the name of the class as an output with which this input vector matches having majority of votes. 2 machine algorithms are combined to form the random forest. Random forest ideas are combined with single modeled trees.

TOOL USED: WEKA known as Waikato Environment for Knowledge Analysis which is constructed in New Zealand in the University of Waikato. This machine learning software is written in Java. WEKA is a collection of visualization tools and algorithms for the predictive modeling [27]. Different types of data mining algorithms can be tested using different type of datasets. The techniques which are supported by the WEKA are Data Processing, Classification, Clustering, Visualization Regression and Feature Selection [21]. There are 5 interfaces in the tool and main user interface is explorer with which we work but all other interfaces provides same functionality just as the explorer [27].

IV. EXPERIMENTAL RESULTS

This research work analyses different classification algorithms accomplishment for Chronic Kidney Disease dataset. Comparison of classifiers for Chronic Kidney Disease dataset is done using criteria accuracy, correctly classified instances, incorrectly classified instances, error rate and execution time to analyse the performance of the classification algorithms and its application domain is also discussed. Models for each algorithm are constructed using two methods maily – Cross Validation with 10 folds out of which training set uses 9 folds and 1 fold for testing and Percentage Split in which 60% of the dataset is used for the training and 40% is used for the testing and output is given according to it.

Figures are shown for the comaprison of the different classifiers for CKD dataset using 10 fold cross validation testing bed. Applications are also discussed of these classifiers in the table. According to the table andresearch the execution time taken by the Random Tree algorithm is least with 0.02 seconds followed by Naïve Bayes with 0.02 seconds, J48 algorithm with 0.1 seconds and multilayer perceptron took much more time for execution which is 8.97 seconds. Accuracy of Multilayer perceptron is 99.75%, J48 with 99%, Random treewith 95.5% and naïve Bayes with 95%. The accuarcies of the algorithms don't have much difference in between. Hence according to the data Multilayer perceptron algorithm is most accurate in case of 10 fold cross validation method.



```
Time taken to build model: 0.03 seconds

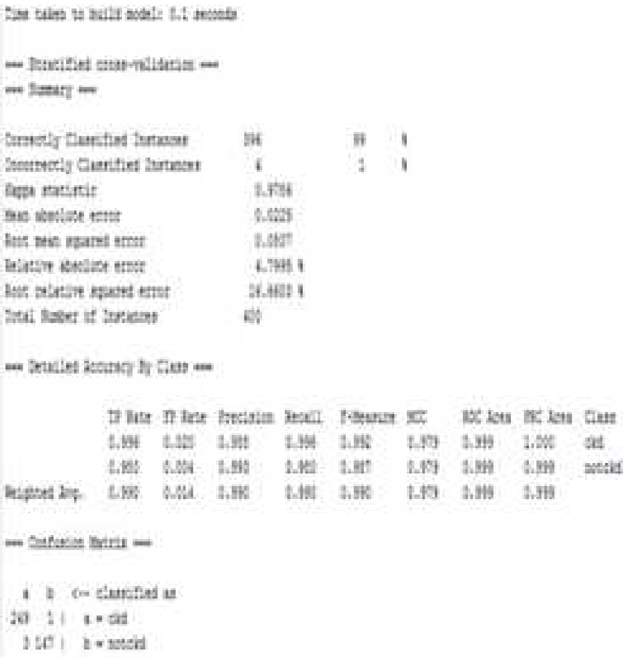
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         380               95      %
Incorrectly Classified Instances        20                5      %
Kappa statistic                          0.8961
Mean absolute error                      0.0479
Root mean squared error                  0.2046
Relative absolute error                 10.2125 %
Root relative squared error             42.2526 %
Total Number of Instances              400

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.920    0.000    1.000      0.920    0.958      0.901    1.000     1.000     ckd
                 1.000    0.080    0.882      1.000    0.938      0.901    1.000     1.000     notckd
Weighted Avg.    0.950    0.030    0.956      0.950    0.951      0.901    1.000     1.000

=== Confusion Matrix ===
```



```
Time taken to build model: 0.1 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         396               99      %
Incorrectly Classified Instances         4                1      %
Kappa statistic                          0.9786
Mean absolute error                      0.0225
Root mean squared error                  0.0907
Relative absolute error                  4.7995 %
Root relative squared error             18.6603 %
Total Number of Instances              400

=== Detailed Accuracy By Class ===

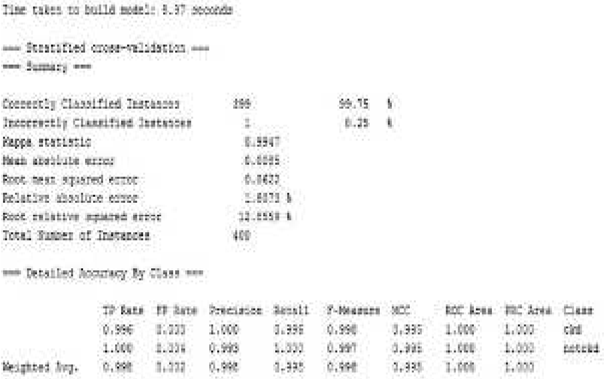
                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.996    0.020    0.988      0.996    0.992      0.979    0.999     1.000     ckd
                 0.980    0.004    0.993      0.980    0.987      0.979    0.999     0.999     notckd
Weighted Avg.    0.990    0.014    0.990      0.990    0.990      0.979    0.999     0.999

=== Confusion Matrix ===

   a   b   <-- classified as
 249   1 |   a = ckd
   3 147 |   b = notckd
```

NAÏVE BAYES

J48



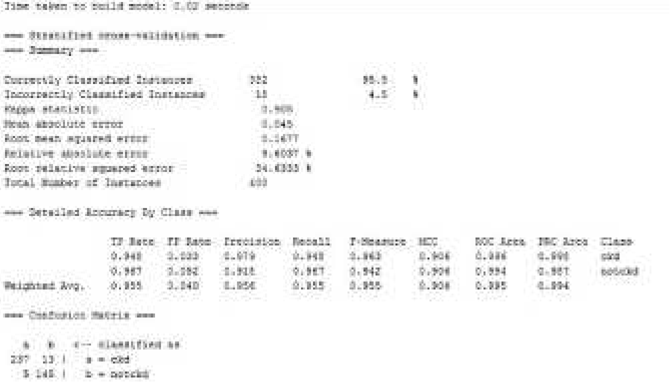
```
Time taken to build model: 8.97 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         399               99.75   %
Incorrectly Classified Instances         1                0.25   %
Kappa statistic                          0.9947
Mean absolute error                      0.0085
Root mean squared error                  0.0622
Relative absolute error                  1.8073 %
Root relative squared error             12.8559 %
Total Number of Instances              400

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.996    0.000    1.000      0.996    0.998      0.995    1.000     1.000     ckd
                 1.000    0.004    0.993      1.000    0.997      0.995    1.000     1.000     notckd
Weighted Avg.    0.998    0.002    0.998      0.998    0.998      0.995    1.000     1.000
```



```
Time taken to build model: 0.02 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         382               95.5    %
Incorrectly Classified Instances        18                4.5    %
Kappa statistic                          0.905
Mean absolute error                      0.045
Root mean squared error                  0.1677
Relative absolute error                  9.6037 %
Root relative squared error             34.6355 %
Total Number of Instances              400

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.948    0.033    0.979      0.948    0.963      0.906    0.986     0.990     ckd
                 0.967    0.052    0.918      0.967    0.942      0.906    0.994     0.987     notckd
Weighted Avg.    0.955    0.040    0.956      0.955    0.955      0.906    0.985     0.994

=== Confusion Matrix ===

   a   b   <-- classified as
 237  13 |   a = ckd
   5 145 |   b = notckd
```

MULTILAYER PERCEPTRON

RANDOM TREE

Figure 6: Result evaluation for different classification algorithm on CKD dataset

For Chronic Kidney Disease				
Classifier	**Naïve Bayes**	**MultilayerPerceptron**	**Random Tree**	**J48**
Testing Bed	Cross Validation	Cross Validation	Cross Validation	Cross validation
Applications	Text classification, Spam filtering, Online Application, Hybrid recommendersystem	Speech recognition, Imagerecognition, Machine translation software [32].	Machine learning, Genetic algorithm, Fault diagnosis, Rotating Machinery [33].	Emotion recognition, Verbal column pathologies.
ExecutionTime	0.03 seconds	8.97 seconds	0.02 seconds	0.1 seconds
Accuracy	95%	99.75%	95.5%	99%

Table 1: Comparison of classifiers for CKD dataset using cross validation testing bed

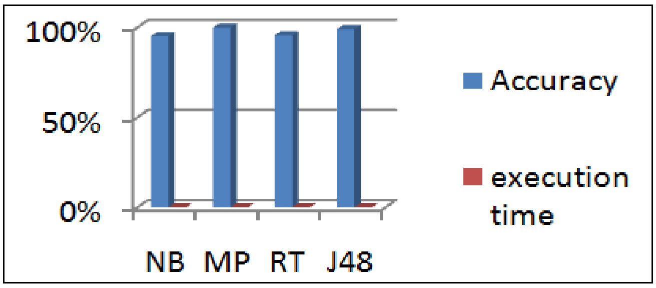
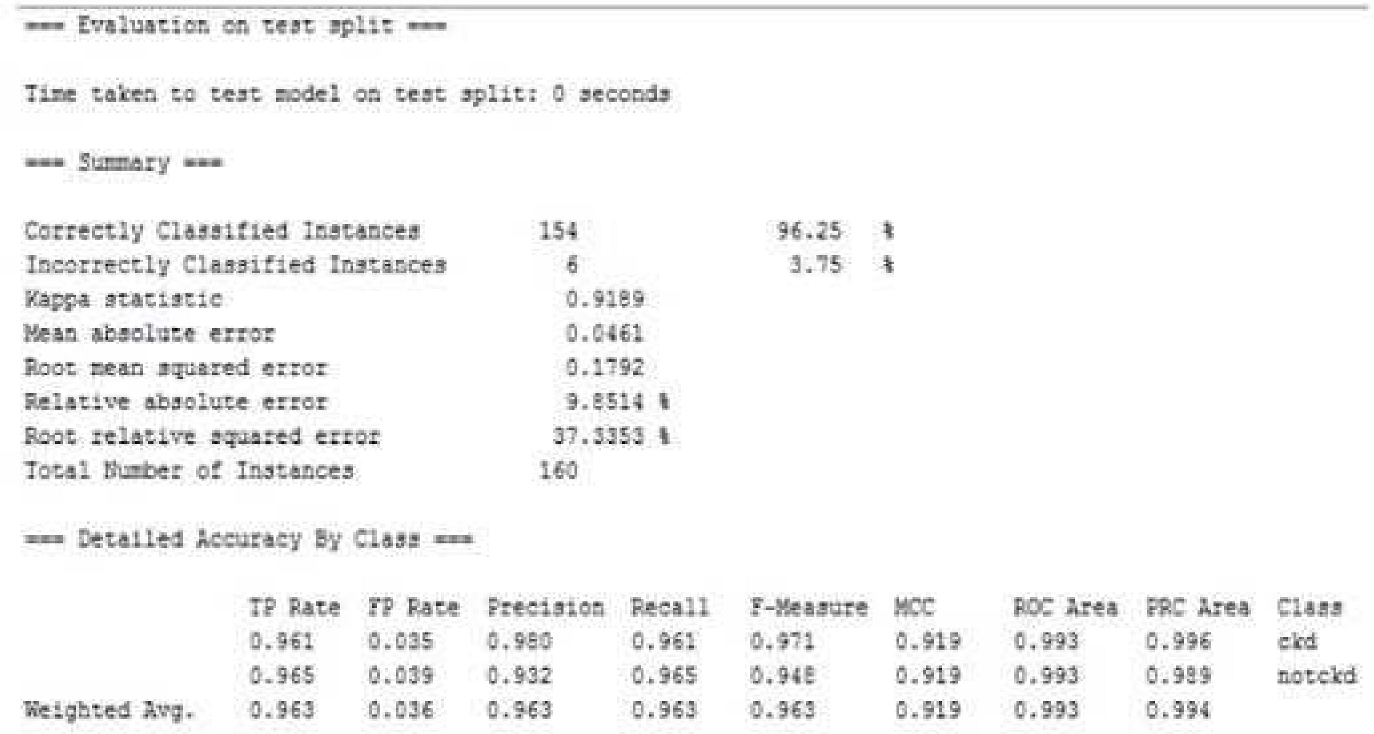


Figure 7: Graphical representation of different algorithms accuracy and execution time using cross validation method.

In the graph the abbreviation NB stands for Naïve Bayes, MP for Multilayer Perceptron, RT for Random Tree. The number of correctly classified instances in Naïve Bayes is 380, Multilayer perceptron with 399, Random tree with 382 and J48 with 396. The incorrectly classified instances by Naïve Bayes is 20, Multilayer perceptron with 1, Random tree with 18 and J48 with 4. Now analysis for CKD using percentage split method is done and this is as below:



```
=== Evaluation on test split ===

Time taken to test model on test split: 0 seconds

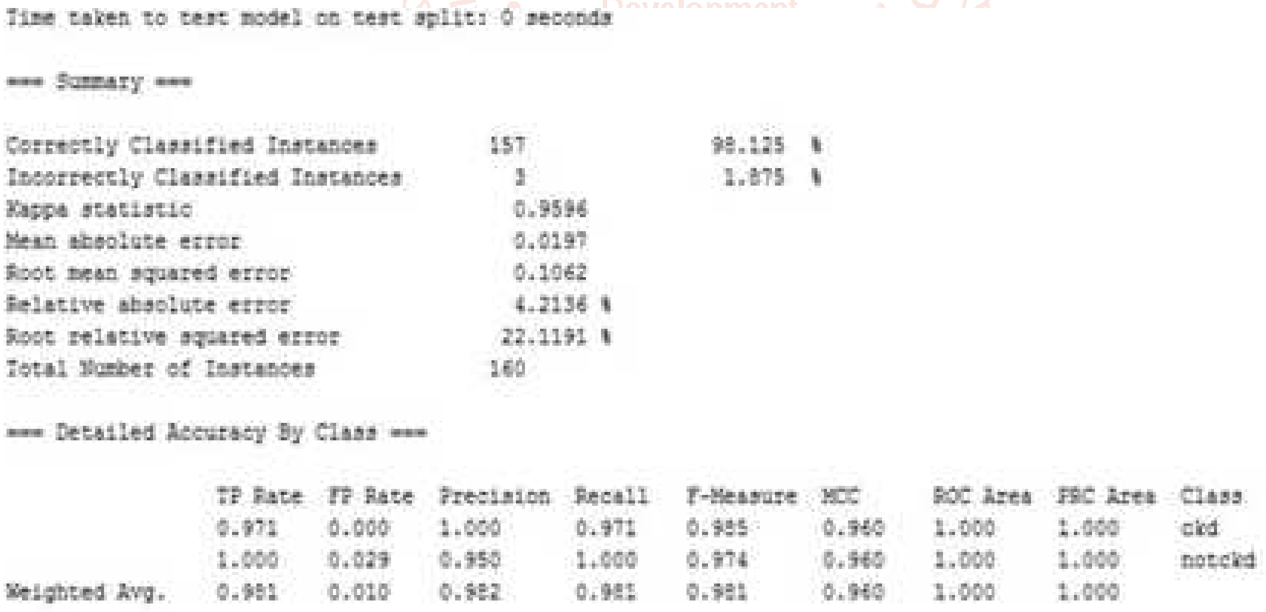
=== Summary ===

Correctly Classified Instances         154               96.25   %
Incorrectly Classified Instances         6                3.75   %
Kappa statistic                          0.9189
Mean absolute error                      0.0461
Root mean squared error                  0.1792
Relative absolute error                  9.8514 %
Root relative squared error             37.3353 %
Total Number of Instances              160

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.961    0.035    0.980      0.961    0.971      0.919    0.993     0.996     ckd
                 0.965    0.039    0.932      0.965    0.948      0.919    0.993     0.989     notckd
Weighted Avg.    0.963    0.036    0.963      0.963    0.963      0.919    0.993     0.994
```

RANDOM TREE



```
Time taken to test model on test split: 0 seconds

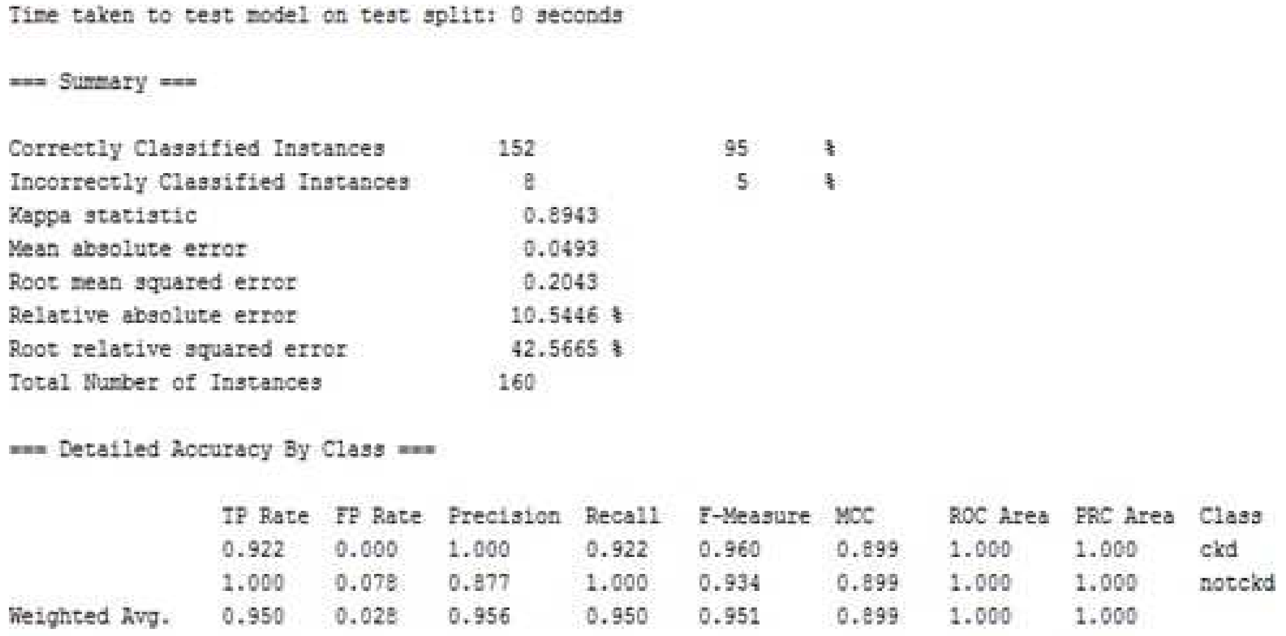
=== Summary ===

Correctly Classified Instances         157               98.125  %
Incorrectly Classified Instances         3                1.875  %
Kappa statistic                          0.9596
Mean absolute error                      0.0197
Root mean squared error                  0.1062
Relative absolute error                  4.2136 %
Root relative squared error             22.1191 %
Total Number of Instances              160

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.971    0.000    1.000      0.971    0.985      0.960    1.000     1.000     ckd
                 1.000    0.029    0.950      1.000    0.974      0.960    1.000     1.000     notckd
Weighted Avg.    0.981    0.010    0.982      0.981    0.981      0.960    1.000     1.000
```

MULTILAYER PERCEPTRON



```
Time taken to test model on test split: 0 seconds

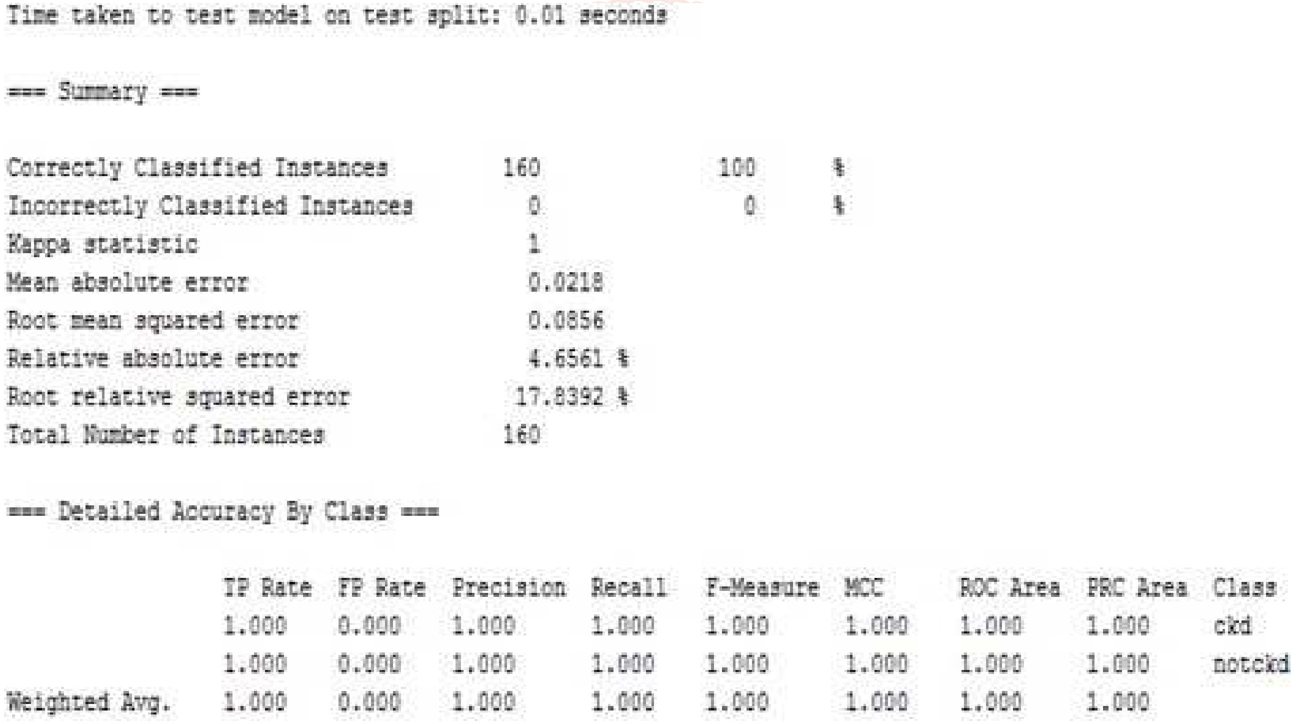
=== Summary ===

Correctly Classified Instances         152               95      %
Incorrectly Classified Instances         8                5      %
Kappa statistic                          0.8943
Mean absolute error                      0.0493
Root mean squared error                  0.2043
Relative absolute error                 10.5446 %
Root relative squared error             42.5665 %
Total Number of Instances              160

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.922    0.000    1.000      0.922    0.960      0.899    1.000     1.000     ckd
                 1.000    0.078    0.877      1.000    0.934      0.899    1.000     1.000     notckd
Weighted Avg.    0.950    0.028    0.956      0.950    0.951      0.899    1.000     1.000
```

NAÏVE BAYES



```
Time taken to test model on test split: 0.01 seconds

=== Summary ===

Correctly Classified Instances         160              100      %
Incorrectly Classified Instances         0                0      %
Kappa statistic                          1
Mean absolute error                      0.0218
Root mean squared error                  0.0856
Relative absolute error                  4.6561 %
Root relative squared error             17.8392 %
Total Number of Instances              160

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 1.000    0.000    1.000      1.000    1.000      1.000    1.000     1.000     ckd
                 1.000    0.000    1.000      1.000    1.000      1.000    1.000     1.000     notckd
Weighted Avg.    1.000    0.000    1.000      1.000    1.000      1.000    1.000     1.000
```

J48 Decision Tree

For Chronic Kidney Disease				
Classifier	NaïveBayes	MultilayerPerceptron	RandomTree	J48
TestingBed	PercentageSplit	PercentageSplit	PercentageSplit	PercentageSplit
ExecutionTime	0 seconds	0 seconds	0 seconds	0.01 seconds
Accuracy	95%	98.125%	96.25%	100%

Tale 2: Comparison of classifiers for CKD dataset using pecrentage split method

According to this test method that is percentage split it can be concluded that Naïve Bayes, Random Tree and Multilayer Perceptron took 0 sceonds for execution while J48 took 0.01 seconds for execution. Accuracy of the J48 algorithm comes out to be 100% while that of Multilayer Perceptron with 98.125%, Naïve Bayes with 95% accurate and random Tree with 96.25% accuarte. The number of correctly classified instancesin Naïve Bayes is 152, Multilayer Perceptron with 157, Random Tree with 154 and J48 with 160. Number of incorrectly classified instances in Naïve Bayes is 8, Multilayer Perceptron with 3, Random Tree with 6 and J48 with 0.

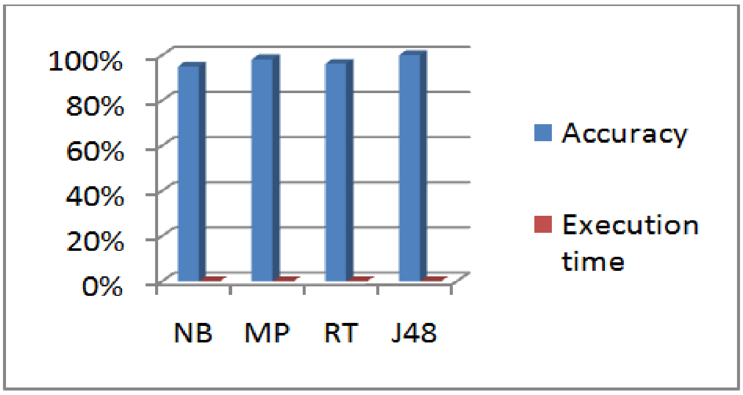


Figure 8: Graphical representation of different algorithms accuracy and execution time in percentage split

Graphical representation of different algorithms accuracy in percentage split method. The abbreviations in the chart stands for Naïve BAyes, Multilayer Perceptron, Random Tree.

Graphical representation of correctly and incorrectly classified instnces by the classifiers are:

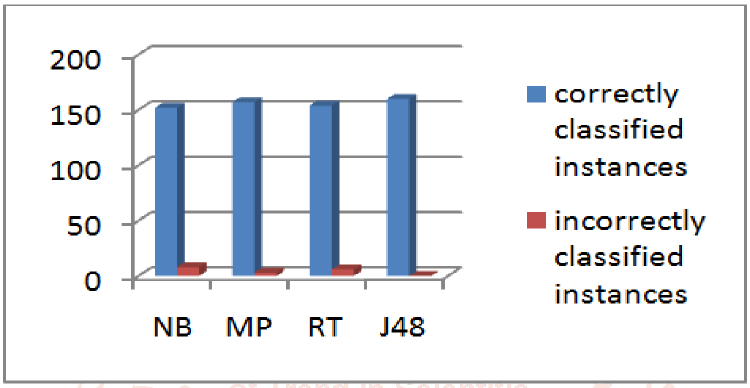


Figure 9: correctly and incorrectly classified instances in case of Percentage Split

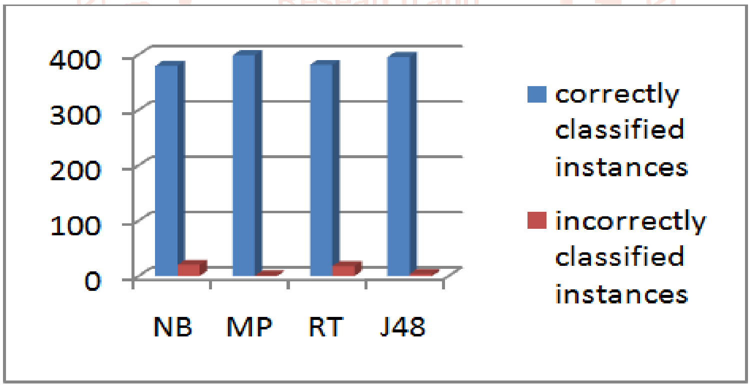


Figure 10: correctly and incorrectly classified instances in case of Cross Validation

From the graphs it is analyzed that there is no such difference between the perfromance of the classification algorithms they have significant performances for the chronic kidney disease dataset but on th basis of graph analysis Multilayer Perceptron classifier is most accurate when using cross validation method andJ48 classifier is most accurate when using percentage split.

V. CONCLUSION

Comparision and investigation of the accomplishment of various classification algorithms is done using different criteria which are accuracy, execution time, correctly classified instances, incorrectly classified instances and error rate. According to the result evaluation it can be concluded that Multilayer Perceptron is most accurate with 99.75% when 10 folds cross validation method is applied for CKD dataset and for Percentage Split method J48 algorithm is most accurate with 100% accuracy. From the figure 7 and 8 it can be analyzed that all the algorithms don't have much significant difference in between their accuracies. Hence type and size of the datasets are the factors on which algorithms performance depends. The further result evaluation study can be done for the performance of other classification techniques with large dataset sample. Clustering, association, sequential patterns etc techniques can be used to draw more efficient results apart from the classification technique

VI. FUTURE WORK

In future focus will be on how to improve the classifiers performance so that classification techniques requiresless time to execute. For enhancing the performance different classification algorithms can be used together.

REFERENCES

[1] https://en.wikipedia.org/wiki/Data_mining

[2] R. Sharma et al, "Comparative Analysis of Classification Techniques in Data Mining Using Different Datasets". International Journal of Computer Science and Mobile Computing, vol. 4, PP 125-134, No. 12(2015).

[3] https://data-flair.training/blogs/data-mining-and-knowledge-discovery/

[4] K. Ahmed, T. Jesmin, "Comparative Analysis of Data Mining Classification Algorithms in Type-2 Diabetes Prediction Data Using Weka Approach". International Journal of Science and Engineering, vol. 7, PP 155-160, No. 2(2014).

[5] C. Anuradaha, T. Velmurugan, "A Comparative Analysis on the Evaluation of Classification Algorithms in the Prediction of Students Performance". International Journal of Science and Technology, vol. 8, No. 15(2015).

[6] S. Gupta, N. Verma, "Comparative Analysis of the Classification Algorithms using Weka Tool". International Journal of Scientific and Engineering Research, vol. 7, No. 8(2014).

[7] R. Sharma et al, "Comparative Analysis of Classification Techniques in Data Mining using Different Datasets". International Journal of Computer Science and Mobile Computing, vol. 4, PP 125-134, No. 12(2015).

[8] N. Orsu et al, "Performance Analysis and Evaluation of Different Data Mining Algorithms used for Cancer Classification". International Journal of Advanced Research in Artificial Intelligence, vol. 2, PP 49-55, No. 5(2013).

[9] S. Khare, S. Kashyap, "A Comparative Analysis of Classification Techniques on Categorical Data inData Mining". International Journal on Recent and Innovation Trends in Computing and Communication, vol. 3, PP 5142-5147, No. 8(2015).

[10] Md. N. Amin, Md. A. Habib, "Comparison of Different Classification Techniques using WEKA for Hematological Data". American Journal of Engineering Research, vol. 4, PP 55-61, No. 3(2015).

[11] S. Carl et al, "Implementation of Classification Algorithms and their Comparisons for EducationalDatasets". International Journal of Innovative Science, Engineering and Technology, vol. 3, PP 700-705, No. 3(2016).

[12] S. Vijayarani, M. Muthulakshmi, "Comparative Analysis of Bayes and Lazy Classification Algorithms". International Journal of Advanced Research in Computer and Communication Engineering, vol. 2, PP 3118-3124, No. 8(2013).

[13] S. Nikam, "A Comparitive Study of Classification Techniques in Data Mining Algorithms". Oriental Journal of Computer Science and Technology, vol. 8, PP 13-19, No. 1(2015).

[14] G. Raj et al, "Comparison of Different Classification Techniques using WEKA for Diabetic Diagnosis". International Journal of Innovative Research in Computer and Communication Engineering, vol. 6, PP 509-516, No. 1(2018).

[15] N. Jagtap et al, "A Comparative Study of Classification Techniques in Data Mining Algorithms". International Journal of Modern Trends in Engineering and Research, vol. 4, PP 58-63, No. 10(2017).

[16] N. Nithya et al, "Comparative Analysis of Classification Function Algorithms in Data Mining". International Conference on Information and Image Processing, PP 272-275, No. 2(2014).

[17] S. Chiranjibi, "A Comparative Study for Data Mining Algorithms in Classification". Journal of Computer Science and Control Systems, vol. 8, PP 29-32, No. 1(2015).

[18] C. Fernandes, et al, "A Comparative Analysis of Decision Tree Algorithms for Predicting Student's Performance". International Journal of Engineering Science and Computing, vol. 7, PP 10489-10492, No.4(2017).

[19] S. Srivastava et al, "Comparative Analysis of Decision tree Classification Algorithms". International Journal of Current Engineering and Technology, vol. 3, PP 334-337, No. 2(2013).

[20] Lohani et al, "Comparative Analysis of Classification Methods Using Privacy Preserving Data Mining". International Journal of Recent Trends in Engineering and Research, vol. 2, PP 677-682, No. 4(2016).

[21] S. Devi, M. Sundaram, “A Comparative Analysis of Meta and Tree Classification Algorithms Using WEKA”. International Research Journal of Engineering and Technology, vol. 3, PP 77-83, No. 11(2016).

[22] S. Priya, M. Venila, “A Study on Classification Algorithms and Performance Analysis of Data Mining Using Cancer Data to Predict Lung Cancer Disease”. International Journal of New technology and Research, vol. 3, PP 88-93, No. 11(2017).

[23] K. Danjuma, A. Osofisan, “Evaluation of Predictive Data Mining Algorithms in Erythemato-Squamous Disease Diagnosis”. International Journal of Computer Science Issues, vol. 11, PP 85-94, No. 1(2014).

[24] N. Kaur, N. Dokania, “Comparative Study of Various Techniques in Data Mining”. International Journal of Engineering Sciences and Research Technology, vol. 7, PP 202-209, N0. 5(2018).

[25] E. Sondakh, R. Pungus, “Comparative Analysis of Three Classification Algorithms in Predicting Computer Science Students Study Duration”. International Journal of Computer and Information Technology, vol. 6, PP 14-18, No. 1(2017).

[26] K. Kishore, M. Reddy, “Comparative Analysis between Classification Algorithms and Data Set (1: N andN: 1) Through WEKA”. Open Access International Journal of Science and Engineering, vol. 2, PP 23-28,No. 5(2017).

[27] https://en.wikipedia.org/wiki/Weka_(machine_learning)

[28] F. Aqlan, R. Markle, “Data Mining for Chronic Kidney Disease”. Proceedings of the 2017 Industrial andSystems Engineering Conference, vol. 4, No. 3(2017).

[29] https://data-flair.training/blogs/classification-algorithms/

[30] https://www.google.com/search?q=naive+bayes+theorem+formula&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjXtcSJr-zbAhXMMY8KHbBVBK0Q_AUICigB&biw=1366&bih=662#imgrc=kwLT20eBUyxVdM:

[31] Mishra, B. Ratha, “Study of Random Forest Data Mining Algorithms for Microarray Data Analysis”. International Journal on Advanced Electrical and Computer Engineering, vol. 3, PP 5-7, No. 4(2016).

[32] https://en.wikipedia.org/wiki/Multilayer_perceptron#Applications

[33] https://link.springer.com/chapter/10.1007/978-1-84628-814-2_82