A Survey on Expert System using Classification Concept

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***Abstract* - In many expert systems classifier technique is successfully applied. Expert system means the system which makes decision based on provided knowledge by human expert and displays the result. Expert System contains knowledge provided by field expert in terms of rules. These rules are match with the system input and display the appropriate result of it. To minimize the effort of rule matching we apply classifier technique. By using decision tree classifier we reduce the size of the records for compare with previously design rules. After find the reduced set we apply rule matching on it and find out the exact rule match with user input.**

***Index Terms* - Expert System, classification, Decision Tree classification, Naïve Bays classification**

I. INTRODUCTION

Expert system is the system which is take input from the user about specific domain and gives the probabilistic result based on the knowledge store in the system in terms of rules. This type of system is known as the Rule-based expert system. Rules are defined by knowledge engineer. Expert system is use for taking decision from the facts in real world.

In Rule-based expert system, system takes some facts from the real world and makes decision based on those facts. But the efficiency of the system is decrease when size of problem domain is large. To improve the efficiency and accuracy we use classification technique in expert system. As we know classification is technique to classify the large data into small classes. Data classification process contains two steps. 1Learning step: In this classifier model is constructed using training dataset. 2. Classification step: In this step constructed model is use to classify the testing data. So, in expert system we try to make small size database using classification.

II. INTRODUCTION TO RULE BASED EXPERT SYSTEM

In this section first of all we understand what are expert system and its working. In expert system knowledge represent is in terms of if-then rules. Rule based expert system means the system which declare rules using if-then statements. Expert system contains components as shown in the figure 1[5]:

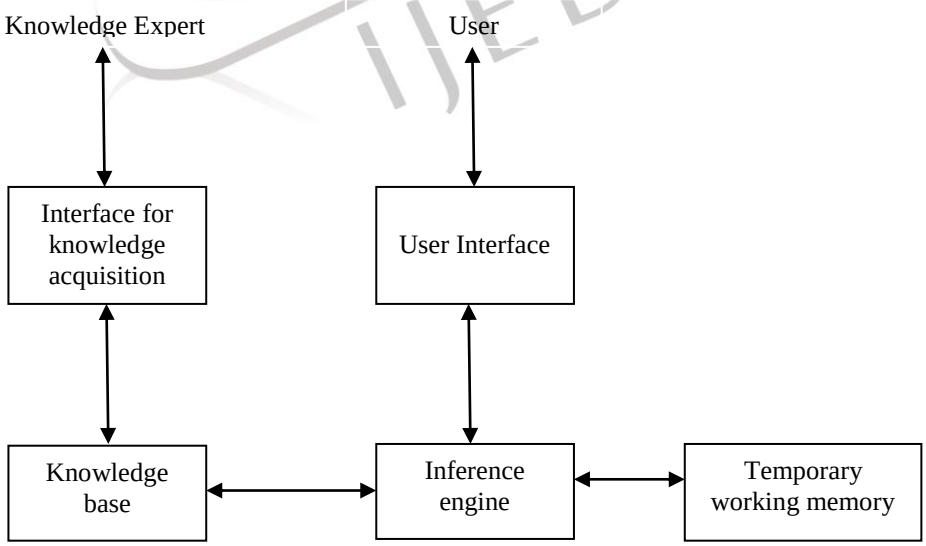

Figure 1: Components of Rule-Based Expert System

As shown in figure1 these are the components of expert system. Knowledge base is a main component of this system. It is also called Rule base. Knowledge base is a collection of rules which are produce by the knowledge engineer through knowledge acquisition. Knowledge is acquired from the knowledge expert. User interface provide the input for the system. After getting the input from the user the Inference engine is come into the work. Inference engine takes input from the user interface and then

perform the matching with the predefined rules which is store in the knowledge base. When it finds the perfect match then it takes decision as describe in the system. For this process of rule matching temporary working memory is used. At last the decision made by the system is transfer to the user or client using user interface.

III. DIFFERENT CLASSIFICATION TECHNIQUES USED IN EXPERT SYSTEM

Classification plays important role in Data mining. Data classification process contains two steps. 1Learning step: In this classifier model is constructed using training dataset. 2. Classification step: In this step constructed model is use to classify the testing data. So, in expert system we try to make small size database using classification. Now, we examine the classification techniques used in expert system. Generally Naïve Bays and Decision tree are use for classification in expert system. But other techniques like SVM, Ada-Boost are also applied in expert system.

Popular classification methods are:

a) **Adaptive Boosting (Ada-Boost) Algorithm:** Adaptive-Boosting [2] is a meta-algorithm. It is used with other classification techniques. By using this algorithm performance is increase. This algorithm is sensitive to noisy and outliers. In this algorithm we can use other learning algorithms as weak classifier for repeatedly until reach to specified terminating condition. Adaptive Boosting is a popular boosting algorithm.

The pseudo code for this algorithm is as below:

Input: D, a set of d class-labeled tuples, k, the number of rounds and a classification learning scheme.

Output: A composite model

Method:

1) Initialize the weight of each weight of each tuple in D to 1/d;
2) For i=1 to k do //for each round
3) sample D with replacement according to the tuple weights to obtain D_i;
4) use training set D_i to derive a model M_i;
5) Compute error (M_i)

$$error(M_i) = \sum_{i=1}^{d} w_j \times err(X_j)$$

6) if error(M_i)>0.5 then
7) go back to step 3 and try again;
8) endif
9) for each tuple in D_i then was correctly classified do
10) multiply the weight of the tuple by error (M_i)/ (1-error(M_i)); // update weights
11) normalized the weight of each tuple;
12) endfor

To use the ensemble to classify tuple, X;

1) initialize weight of each class to 0;
2) for i=1 to k do // for each classifier;
3) $w_i=\log\frac{1-error(Mi)}{error\ (Mi)}$; // weight of the classifier's vote
4) c= $M_i(X)$; // get class prediction for X from M_i
5) add w_i to weight for class c
6) endfor
7) return the class with the largest weight;

Figure 2: Adaboost, a boosting algorithm

b) **Decision tree algorithm**: Decision tree [3] is a structure which is look like a flowchart structure, in this algorithm we perform specific test on an attribute which represented as a internal node of tree and leaf node represents the class label. Tree contains only one root node which indicates the starting of tree. This algorithm is simple and fast. Rules are easily converted to this algorithm. The accuracy of the decision tree algorithm is good. C4.5 is the most efficient and useful algorithm used for decision tree-based approach. In this algorithm initially dataset is sorted according to attribute value. This procedure is continuing until all the attributes are classified. When node of a tree contains same attribute records then that node is consider as a leaf node as represent the class label. Decision tree is performing well when size of a dataset is large. This algorithm is deal with the different types of attributes 1) Discrete valued: in this type, possible value of node N is known and the procedure of splitting is performing based on these values. 2) Continuous valued: in this splitting condition is define and based on this condition node N have only two possible outputs.3) Discrete valued but a binary tree must be produced: for this we check where the value of attribute is match with the condition or not. It generates only two branches yes or no.

The pseudo code of this algorithm is as below:

Input: Data partition D, attribute list, Attribute selection method.

Output: a decision tree
Method:

1) create a node N;
2) if tuples in D are all of the same class C then
3) return N as a leaf node labeled with the class C;
4) if attribute_list is empty then
5) return N as a leaf node labeled with the majority class in D; //majority voting
6) apply Attributr_selection_method(D,attributr_list) to find the best splitting_criterion;
7) label node N with splitting_criterion;
8) if splitting_attribute is discrete value and
multiple splits allowed then
9) attribute_list ← attribute_list-splitting_attribute;
10) for each outcome j of splitting_criterion
11) let D_j be the set of data tuples in D satisfying outcome j;
12) if D_j is empty then
13) attach a leaf labeled with the majority class in D to node N;
14) else attach the node return by generate_decision_tree(D_j, attribute_list) to node N;
15) endfor
16) return N;

Figure 3: basic algorithm for inducing a decision tree from training tuples

c) **Naïve- Bays algorithm:** This algorithm is created based on Bay's theorem. It is based on the posterior probability. It is a statistical classifier. They can predict class membership probabilities such as the probability that a given tuple belongs to a particular class. Naïve Bayesian classifiers assume that the effect of an attribute value on a given class is independent of the values of the other attributes. This algorithm is perform accuratly when the size of the dataset is medium or large. The result of both algorithm decision tree and naïve bays are very comparitive in different domains.

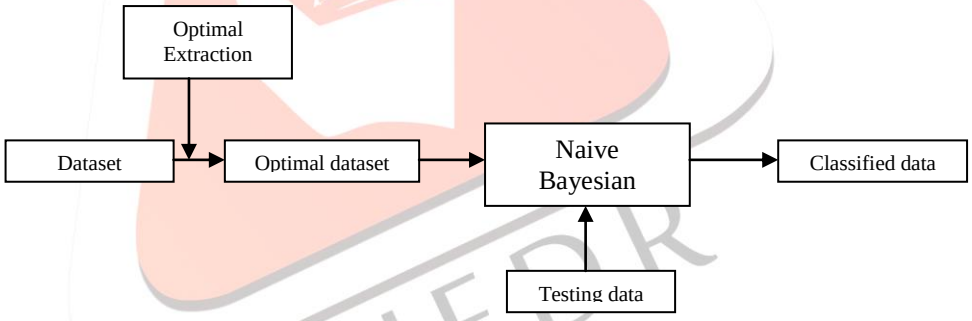

Figure 4: Architecture of Expert System using Naïve-Bays classification [4]

This architecture in figure is proposed expert system using the naïve bays classification. In initial step the dataset is minimize using the simple selection step on real dataset. Then Naïve Bayesian classification was considered that optimal dataset for further classification. By using the classification in expert system we increase the efficiency of the system.

IV. COMPARISION

As mention in previous section different classification techniques are used in different domain of expert system. Before choosing the classification technique we compare the different classifier using weka. In different paper comparison of different classification is given. Most probably Decision tree C4.5 and Naïve bays are used in expert system. Here I represent the confusion matrix of these two algorithms based on "DECISION TREE AND NAÏVE BYES ALGORITHM FOR CLASSIFICATION AND GENERATION OF ACTIONABLE KNOWLEDGE FOR DIRECT MARKETING." [3]

Table 1: confusion matrix of C4.5 algorithm

	Predicted class		
Actual class		Yes	No
	Yes	337	184
	No	89	3911

Table2: confusion matrix of Naïve Bays algorithm

	Predicted class		
Actual class		Yes	No
	Yes	264	257
	No	298	3702

Comparison between the performance of different classification techniques on same dataset is perform using the weka tool easily before using that technique in particular domain of expert system. Here, I represent the comparison based on the size of dataset used in system Figure 5 indicates the result when the size of the dataset is small and same classification technique is perform differently when the size of dataset is large.

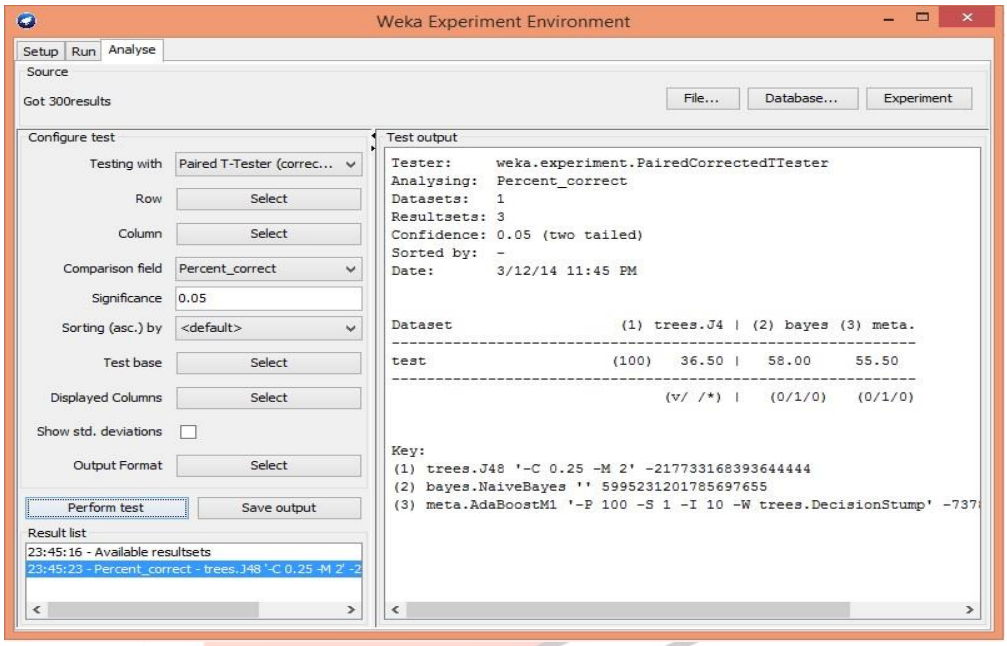

Figure 5: snapshot of comparison of classification technique using small dataset

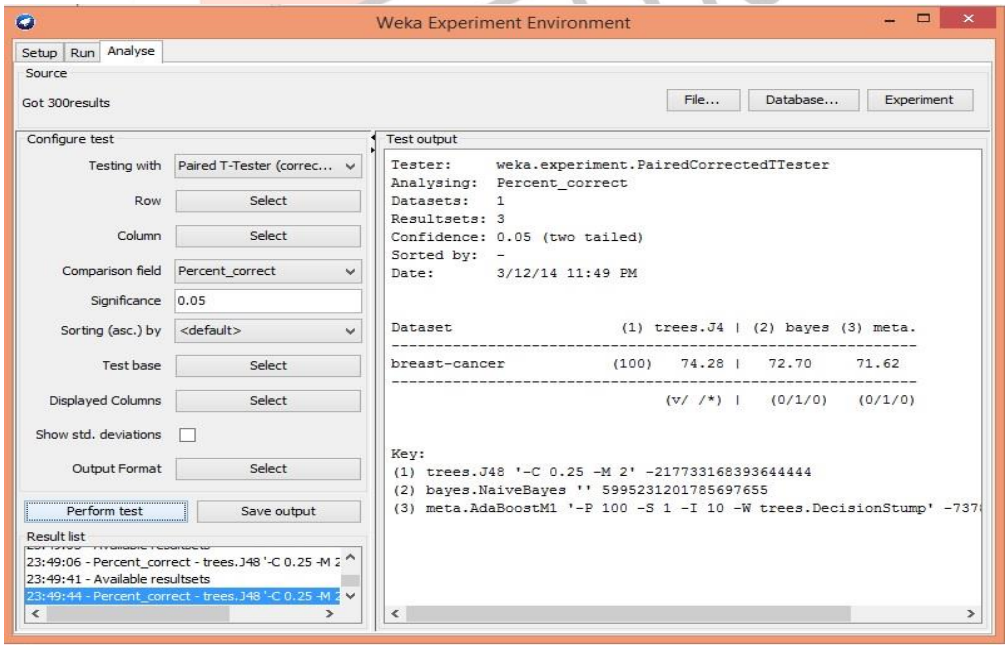

Figure 6: snapshot of comparison of classification technique using large dataset

V. CONCLUSION AND FUTURE WORK

This survey contains information of classification techniques applied in expert system. In this survey we study about where to apply the classification techniques in expert system. Different technique of classification is performing differently in different environment. Accuracy of the classification is dependent on the problem domain dataset. In one environment it works better and in other it not performs efficiently. So it is based on the problem domain which classification technique is applied. In future you can apply any classification technique in expert system. Expert system is broadly used in medical domain, business decision making and so many areas. So, you can apply classification to improve the result of the expert system.

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