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# CLASSIFICATION AND PREDICTION IN CUSTOMER RELATIONSHIP MANAGEMENT USING BACK PROPAGATION

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**Abstract**— Customer Relationship Management provides a customer classification and prediction which is used for the optimization of business process. The classification and prediction which is used for the optimization of business process. This classification and prediction in CRM will help the company to study, analyze and forecast customers pattern of consumption, business transaction and purchasing CRM has become major activity in the enterprise based business organization using the CRM. CRM is an important activity in the enterprise business organization like banking industry, insurance industry, retail industry and manufacture industry. In the system we are using data mining techniques to implement customer classification in CRM as we need to analyze mass volume of data we are implementing an efficient and effective Neural Network based technique. Based on the existing system like Naïve Bayesian System, our proposed system implements Back propagation Neural Network techniques which would generate accurate results with less time complexity.

**Keywords**— Classification, Prediction, Data Mining, Naïve Bayesian Algorithm, Back propagation, Neural networks.

## I. INTRODUCTION

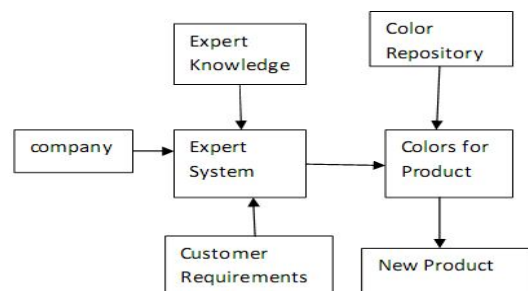
The core part of CRM activities is to understand customer requirements and retain profitable customers. To reach it in a highly competitive market, satisfying customer's needs is the key to business success [1]. Unprecedented growth of competition has raised the importance of retaining current customers. Retaining existing customers is much less expensive and difficult than recruiting new customers in a mature market. So customer retention is a significant stage in Customer Relation Management, which is also the most important growth point of profit [3]. Factors that influence customer satisfaction degree are concerned by all enterprise managers [9]. Marketing literature states that it is more costly to engage a new customer than to retain an existing loyal customer. Churn prediction models are developed by academics and practitioners to effectively manage and control customer churn in order to retain existing customers [4]. So, Customer satisfaction is most important.

Data mining (DM) methodology has a tremendous contribution for researchers to extract the hidden knowledge and information which have been inherited in the data used by researchers [7]. Data mining has a tremendous contribution to the extraction of knowledge and information which have been hidden in a large volume of data [8]. The concept of customer satisfaction and loyalty (CS&L) has attracted much attention in recent years. A key motivation for the fast growing emphasis on CS&L can be attributed to the fact that higher customer satisfaction and loyalty can lead to stronger competitive position resulting in larger market share and profitability [6][7].

However, it is a difficult and a complex task to identify the customer's needs such as colors and

design of the products. The objective of this paper is to design and implement the expert system in order to assess customer satisfaction and reveal appropriate strategies to improve it. As the customer satisfaction on colors and design can have a complex hidden pattern and, therefore, the approach of the paper should have an ability to perform pattern recognition, classification and forecast which make the artificial neural networks an appropriate technique to be applied in the expert system[9]. The conceptual work of the paper is illustrated in Figure 1, in which the assumption of the customer requirements and expert system are based upon the statement that "in general, the same customer group will like the same colors". A vast variety of colors mixing in different products that makes it a difficult and complicated task to identify the customer's needs. The contribution of this paper is in designing the system that is the combination of the expert system and the ANN. The customers can interact with the interface of the expert system to ask and get the advices from the system. Correlation Coefficient can be found. According to that, we can identify the customer's behavior [8][9]. 2

Figure 1. The Conceptual Work



This paper is organized as follows: Section II describes related review. Section III describes

Architecture of CRM based on Data Mining, Section IV describes proposed work (Methodology) . Section V describes implementation details. Section VI presents experimental results and performance analysis. Section VII presents conclusion and future scope.

## II. LITERATURE REVIEW

In the process of economic development, business management concept evolved from product-oriented idea to market-oriented idea, and then to customer-oriented idea. Whether enterprises can obtain, maintain and develop their own clients or not has become the most critical factor because customers are important strategic resources. Customer Relationship Management(CRM) is based on the respect to customers and it can help enterprises understand the entire life cycle of the customers and enable enterprises to provide the customers with more personalized and more efficient services, and then it can enhance customer satisfaction and loyalty, and improve the competitiveness of enterprises ultimately. Customer segmentation, as the core of CRM, is to classify the customers according to the customer's attributes, behavior, needs, preferences, value and other factors in a clear business strategy and specific market, and it can provide appropriate products, services and marketing models to the customers.

### A. Data Mining and CRM

The first and simplest analytical step in data mining is to describe the data. For example, you can summarize data's statistical attributes (such as means and standard deviations), visually review data using charts and graphs and look at the distribution of field values in your data. But data description alone cannot provide an action plan. You must build a predictive model based on patterns determined from known results and then test that model on results outside the original sample[1][2]. A good model should never be confused with reality (you know a road map isn't a perfect representation of the actual road), but it can be a useful guide to understanding your business. Data mining can be used for both classification and regression problems. In classification problems you're predicting what category something falls into – for example, whether or not a person is a good credit risk or which of several offers someone is most likely to accept. In regression problems, you're predicting a number, such as the probability that a person will respond to an offer. In CRM, data mining is frequently used to assign a score to a particular customer or prospect indicating the likelihood that the individual behaves the way you want [1][2][3]. For example, a score could measure the propensity to

respond to a particular offer or to switch to a competitor's product. It is also frequently used to identify a set of characteristics (called a profile) that segments customers into groups with similar behaviors, such as buying a particular product. A special type of classification can recommend items based on similar interests held by groups of customers. This is sometimes called collaborative filtering.

### B. Expert System

The expert system's role is in the preparation to capture the knowledge of the experts and the data from the customer's requirements. The system has the capability to compile the collected data and form the appropriate rules for choosing fragrance notes for the products. In order to identify the hidden pattern of the customer's needs, the artificial neural networks technique has been applied to classify the fragrance notes based upon a list of selected information [3]. The expert system's role is in the preparation to capture the data from the customer's requirements and predict appropriate perfume. For this end, factors of perfume costumers' decision were recognized using Fuzzy Delphi method and a back propagation neural network classification model was developed and trained with 2303 data of customers [4]. The proposed business intelligent system for demand forecasting proves to give more accurate prediction for future demands compared to the existing models and practices in spare parts inventory management. This helps inventory managers to better manage their supply chain performance by reducing reaching days and service level simultaneously. Reaching day as a measure of inventory level is generally reduced successfully by the retailers at the cost of service level in most of the places [5].

### C. Bayesian Classification

Bayesian classification is based on Bayes theorem. Studies comparing classification algorithms have found a simple Bayesian classifier known as the naive Bayesian classifier to be comparable in performance with decision and neural network classifiers. Bayesian classifiers have also exhibited high accuracy and speed when applied to large databases. The naive Bayesian classifier works as follows, as in[7]:

1. Each data sample is represented by an  $n$ -dimensional feature vector  $X = (x_1, x_2, \dots, x_n)$ , depicting  $n$  measurements made on the sample from  $n$  attributes, respectively,  $A_1, A_2, \dots, A_n$ .
2. Suppose that there are  $m$  classes,  $C_1, C_2, \dots, C_m$ . Given an unknown data sample,  $X$  (having no class label), the classifier will predict that  $X$  belongs to the class having the highest 3

posterior probability, conditioned on  $X$ . That is, the naïve Bayesian classifier assigns an unknown sample  $X$  to the class  $C_i$  if and only if  $P(C_i | X) > P(C_j | X)$  for  $1 \leq j \leq m, j \neq i$ .

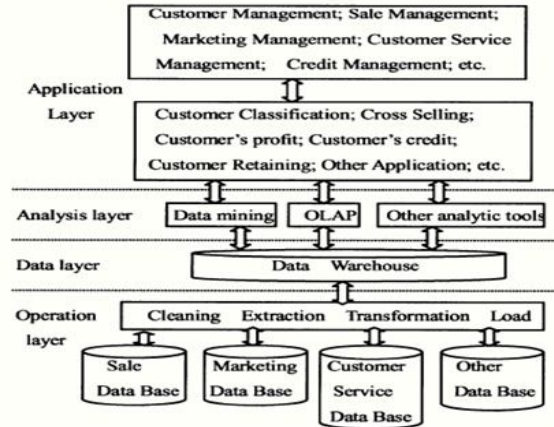
Thus we maximize  $P(C_i | X)$ . The class  $C_i$  for which  $P(C_i | X)$  is maximized is called the maximum posterior hypothesis. By Bayes theorem,  $P(C_i | X) = P(X | C_i)P(C_i) / P(X)$

3. As  $P(X)$  is constant for all classes, only  $P(X | C_i)P(C_i)$  need be maximized. If the class prior probabilities are not known, then it is commonly assumed that the classes are equally likely, that is,  $P(C_1) = P(C_2) = \dots = P(C_m)$  and we would therefore maximize  $P(X | C_i)$ . Otherwise, we maximize  $P(X | C_i)P(C_i)$ .

4. Given data sets with many attributes, it would be extremely computationally expensive to compute  $P(X | C_i)$ . In order to reduce computation in evaluating  $P(X | C_i)$ , the naïve assumption of class conditional independence is made. This presumes that the values of the attributes are conditionally independent of one another, given the class label of the sample, that is, there are no dependence relationships among the attributes. This can be explained using an Example as follows. Suppose commercial banks hope to increase the customers who will propose credit card. There is a large number of valuable customer information in huge amounts of data accumulated by commercial banks, which is used to identify customers and provide decision support. We wish to predict the class label of an unknown sample using naïve Bayesian classification, given the training data as Table 1. The data samples are described by the attributes: sex, age, student and income. The class label attribute, creditcard\_proposing has two distinct values (namely, {yes, no}).

**III. SYSTEM ARCHIRECTURE**

If data warehouse, OLAP and other data analytic tools are directly applied to enterprise's data base, for example sale data base, marketing data base and customer service data base, it will be not only waste time and substance but also not ideality, therefore, it is wise that the data of business data base is lead to data warehouse after was cleaned, extracted, transformed, loaded, the data of data warehouse will offer the best data resource for the application of data mining. The data analysis will become great efficiency based on the data warehouse. The architecture of CRM based on data warehouse is shown in Figure 3.1.



Architecture of CRM Based on Data Mining

**IV. PROPOSED WORK ( BACK PROPOGATION BASED CLASSIFICATION)**

*A. Classification*

Classification is a data mining (machine learning) technique used to predict group membership for data instances. For example, you may wish to use classification to predict whether the weather on a particular day will be “sunny”, “rainy” or “cloudy”. Popular classification techniques include decision trees and neural networks. It can be formally defined as

Given a collection of records (*training set*)

– Each record contains a set of *attributes*, one of the attributes is the *class*.

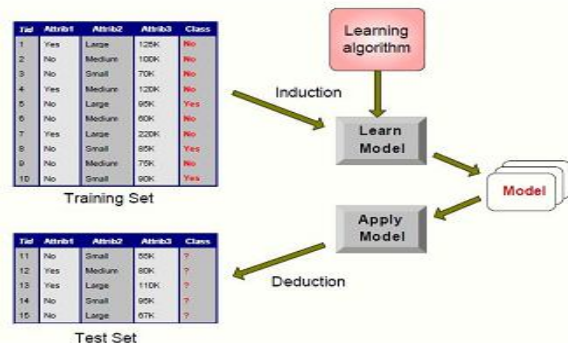
Find a *model* for class attribute as a function of the values of other attributes.

Goal: previously unseen records should be assigned a class as accurately as possible.

– A *test set* is used to determine the accuracy of the model. Usually, the given data set is divided into training and test sets, with training set used to build the model and test set used to validate it.

The following diagram illustrates the classification task.

Figure 4.1



Classification Process.

**B. Back Propagation**

Multilayer perception 1 & BP (Back-propagation) model Standard multilayer perception (MLP) architecture consists more than 2 layers; A MLP can have any number of layers, units per layer, network inputs, and network outputs such as fig 4.2 models. This network has 3 Layers; first layer is called input layer and last layer is called output layer; in between first and last layers which are called hidden layers. Finally, 4 this network has three network inputs, one network output and hidden layer network.

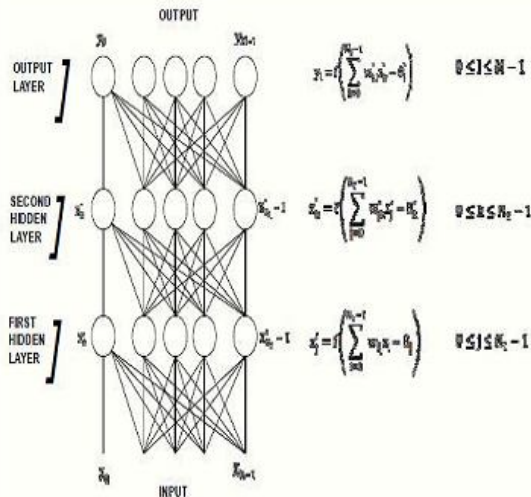


Fig4.2 Standard Multi layer perceptron architecture

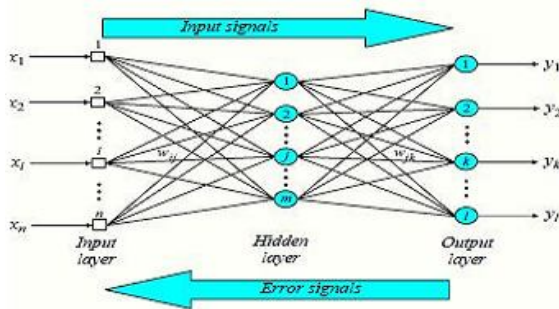


Fig 4.3 Back-propagation neural network

This model is the most popular in the supervised learning architecture because of the weight error correct rules. It is considered a generalization of the delta rule for nonlinear activation functions and multilayer networks. In a back-propagation neural network, the learning algorithm has two phases. First, a training input pattern is presented to the network input layer. The network propagates the input pattern from layer to layer until the output pattern is generated by the output layer. If this pattern is different from the desired output, an error is calculated and then propagated backward through the network from the output layer to the input layer. The weights are modified as the error is propagated. According to the

Richard P. Lippmann, he represents step of the back-propagation training algorithm and explanation. The back-propagation training algorithm is an iterative gradient designed to minimize the mean square error between the actual output of multi-layer feed forward perception and the desired output. It requires continuous differentiable non-linearity. The following assumes a sigmoid logistic nonlinearity.

Step1: Initialize weights and offsets Set all weights and node offsets to small random values. Step2: Present input and desired outputs Present a continuous valued input vector  $X_0, X_1, \dots, X_{N-1}$  and specify the desired output  $d_0, d_1, \dots, d_{M-1}$ . If the net is used as a classifier then all desired outputs are typically set to zero except for that corresponding to the class the input is from. That desired output is 1. The input could be new on each trial or samples from a training set could be presented cyclically until stabilize.

Step 3: Calculate Actual Output

Use the sigmoid non linearity from above and formulas as in fig 3 to calculate output  $y_0, y_1, \dots, y_{M-1}$ . Step 4: Adapt weights Use a recursive algorithm starting at the output nodes and working back to the first hidden layer. Adjust weights by

$$W_{ij}(t+1) = W_{ij}(t) + \eta \delta_j x_i' \quad (1)$$

In this equation  $W_{ij}(t)$  is the weight from hidden node  $I$  or from an input to node  $j$  at time  $t$ ,  $w_j$ , is either the output of node  $i$  or is an input,  $\eta$  is a gain term, and  $\delta_j$ , is an error term for node  $j$ , if node  $j$  is an output node, then

$$\delta_j = y_j(1-y_j)(d_j-y_j) \quad (2)$$

where  $d_j$  s the desired output of node  $j$  and  $y_j$  is the actual output.

Step 5: Repeat by going to step 2

**V. IMPLEMENTATION DETAILS**

In this section, we analyze the performance of our new approach for classifying the customer credit card data using back propagation approach and predicting the who likely customers to our new business are. This we compare with Bayesian classification approach. The Algorithms were implemented in DOT NET Frame work using C# language. Forms framework is used for designing GUI. We have placed transactional data records in data sets. The SQL Server 2000 data base is used for managing the performance results.

**VI. EXPERIMENTAL RESULTS**

In order to evaluate the performance of our proposed algorithm, we have conducted experiments on a PC (CPU: Intel(R) Core2Duo, 3.16GHz) with 4GByte of main memory running Windows XP. The following shows the results of Back propagation Classification Algorithm for generating customer relationship prediction.

**CustomerDataUpdate**  
**Customer Data Update (Customer Profile)**

Customerid: 789      DateOfBirth: 02-Jul-1987

Name: Leeleni      Age: 24

Address: Guntur      Profession: Employee

Income: 160000

Sex:  Male  FeMale      CreditCard:  Yes  No

Buttons: Store, Close

Fig 6.1 Customer Profile Updation 5

**PrepareTrainingData**

Gender	Age	Profession	Income
Male	28	Student	250000
Male	26	Student	250000
Male	26	Student	250000
Male	29	Student	2500000
Male	37	Student	2500
Female	47	Student	1500
Male	44	Student	1500
Male	56	Student	800000
Male	29	Student	350000
Male	38	Student	1200000
Male	29	Student	500000

Fig 6.2 Preparing training Data

**NaiveBayesianClassification**

Customerid: 789Kuman      DateOfBirth: 3-Mar-1987

Name: Sai      Age: 25

Address: Hyderabad      Profession: Select.....

Income: 180000

Sex:  Male  FeMale      CreditCard:  Yes  No

Buttons: Predict, Close

Probability for credit card Yes=0.9957 Probability for credit card No=0.00429999999999997

Fig 6.3 Naïve Bayesian Classification of Data

**BackPropagationClassification**

Customerid: 987      DateOfBirth: 3-Mar-1987

Name: Sai Kumar      Age: 25

Address: Hyderabad      Profession: Employee

Income: 200000

Sex:  Male  FeMale      CreditCard:  Yes  No

Buttons: Predict, Close

Probability for credit card Yes=2 Probability for credit card No=-1

Fig 6.4 Back Propagation Classification of data.

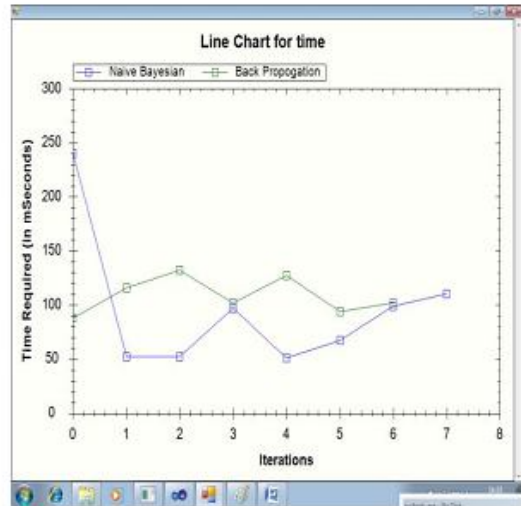


Fig 6.5 Time Complexity comparison of Naïve Bayesian Classification and back propagation Classification

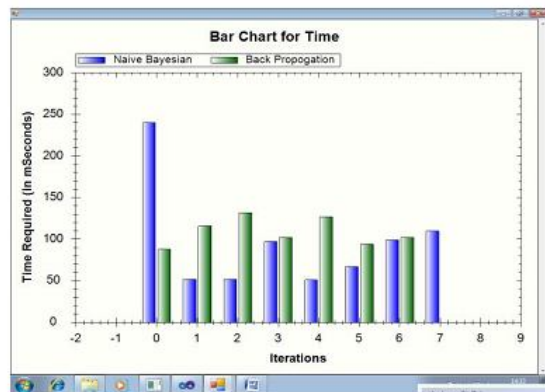


Fig 6.6 Time Complexity comparison of Naïve Bayesian Classification and back propagation Classification.

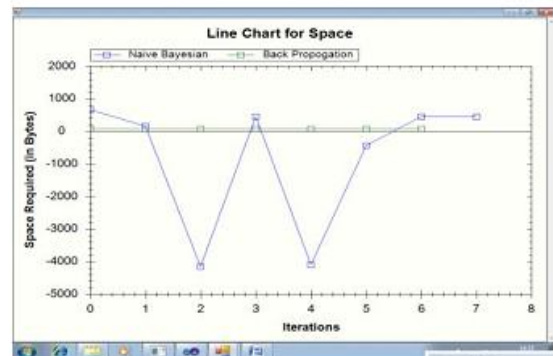


Fig 6.7 Space Complexity comparison of Naïve Bayesian Classification and back propagation Classification

**VII. CONCLUSION AND FUTURE WORK**

In the dynamic business environment, information systems need to evolve to adapt to new requirements, which may be driven by CRM. The paper has presented a framework of an evolving information system based on knowledge from data mining, and has discussed the framework by focusing on

knowledge of classification. Data mining provides the technology to analyze mass volume of data and/or detect hidden patterns in data to convert raw data into valuable information. This paper mainly focused on the research of the customer classification and prediction in Customer Relation Management concerned with data mining based on Back propagation technique.

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