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Intelligent Churn prediction for Telecommunication Industry

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ABSTRACT: Customer churn is a focal concern for most of the services based companies which have fixed operating costs. Among various industries which suffer from this issue, telecommunications industry can be considered at the top of the list. In order to counter this problem one must recognize the churners before they churn. This work develops an effective and efficient model which has the ability to predict the future churners for broadband internet services. For this purpose Genetic Programming (GP) is employed to evolve a suitable classifier by using the customer based features. Genetic Programming (GP) is population based heuristic used to solve complex multimodal optimization problems. It is an evolutionary approach use the Darwinian principle of natural selection (survival of the fittest) analogs with various naturally occurring operations, including crossover (sexual recombination), mutation (to randomly perturbed or change the respective gene value) and gene duplication. The intelligence induced in the system not only generalizes the model for a variety of real world applications but also make it adaptable for dynamic environment. Comprehensive experimentations are performed in order to validate the effectiveness and robustness of the proposed system. It is clear from the experimental results that the proposed system outperforms other state of the art churn prediction techniques.

KEYWORDS: Genetic Programming, Churn Prediction, Artificial Neural Networks, Support Vector Machines, Broadband Networks.

1 INTRODUCTION

In today's business world services based companies with fixed operational cost are recognizing that customer value and increased revenue is more likely to come from their existing customer-base than from new customer acquisition. There are several reasons why retaining existing customers is important. The first reason is that markets have become saturated to a point where new customer in the business is scarce. The second reason is cost. New customer acquisition can be costly to a business for a numerous reasons. It has been reported that the acquisition of new customers can be over ten times more costly to a business than retaining existing customers. This is largely because in saturated markets, the acquisition of new customers often involves enticing customers away from competitors through offers of expensive special deals [1].

Customer retention addresses the issue of customer churn, where churn describes the turnover of customers, and churn management describes the efforts a company makes to identify and control the problem of customer churn [2]. There are a number of contemporary techniques in literature that address this issue. Jadhav and Pawar [3] used Back Propagation neural network algorithm for customer churn prediction. Euler [4] used Decision Tree for finding out the number of churners in near future. Radosavljevik et al. [5] proposed a churn prediction model which incorporates different outcome churn definitions in customer churn and also measure the impact of this change in definitions on the model performance. In addition, there are a variety of other hybrid intelligent techniques that explore capabilities of Artificial Neural Networks (ANN) and Decision Trees (DT) [6-9].

In order to manage customer churn within a company it is important to build an effective and accurate customer churn prediction model. Some techniques used in literature are as follows:

- Classification and regression trees (CART)
- Logistic regression models (LRM)
- Artificial neural networks (ANN)
- K-means Cluster Algorithm
- Support Vector Machine (SVM)

In this work we propose an intelligent churn prediction system based on Genetic Programming (GP). The advantage of using such technique comes from the fact that GP is able to exploit hidden dependencies in feature space that are skipped otherwise. Another benefit is that once a suitable and generalized mathematical expression is evolved through GP simulation, it can be used for future customer churn predictions.

The rest of the paper is organized as follows. Some preliminaries of churn prediction and GP are discussed in section 2. Section 3 describes the proposed GP based churn prediction technique. Experimental results are presented and discussed in section 4. Section 5 concludes this work.

2 CUSTOMER CHURN AND GENETIC PROGRAMMING

The problem of customer churn can be viewed in a number of ways. Knowing exactly what contributed to a specific customer's churn decision is far beyond the scope of a generalized research. As reported in [6], there are many contributing factors towards customer churn as shown in figure 1. From the figure it is clear that price is the main reason for customer churning in telecommunications industry.

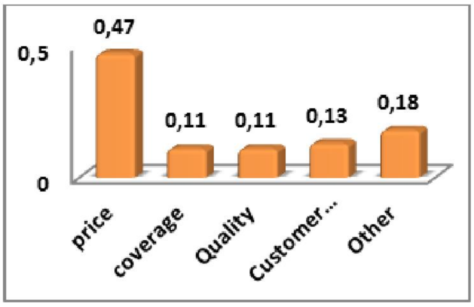

Fig. 1. Main churn contributors for the telecommunications Industry as reported in [6]

2.1 GENETIC PROGRAMMING

Genetic Programming belongs to a class of stochastic search techniques which imitate biological evolution. The process is comprised of generational search of populations. The population in each generation is evaluated using some fitness function and then numerically scored. The best individuals (candidate solutions) in a population are then passed on to the next generation by applying genetic operators namely, crossover, mutation and replication. Further information on GP can be found in [10].

3 PROPOSE INTELLIGENT CHURN PREDICTION TECHNIQUE

The features selected regarding customer attributes in our proposed scheme are listed in table 1. Due to limitations on data availability, we have considered seven features in this work. Introduction of additional features will, however, enhance the performance of the proposed system. Figure 2 shows the basic architecture of the proposed technique which comprises of training and testing modules.

Table 1. Customer Dataset fields

Field Name	Description
Age	Age of the customer.
Paid amount	Billing amount paid in a month
Net Local Calls	No. of local calls
NWD Call	No. of Nationwide calls
Local Mobile calls	No. of local mobile calls
NWD Mobile	No. of Nationwide mobile calls
OS Calls	No. of Overseas calls

3.1 GP BASED CLASSIFIER EVOLUTION

3.1.1 GP MODULE

To represent a possible solution with a GP tree, one needs to define suitable functions, terminals, and fitness criteria according to the optimization problem.

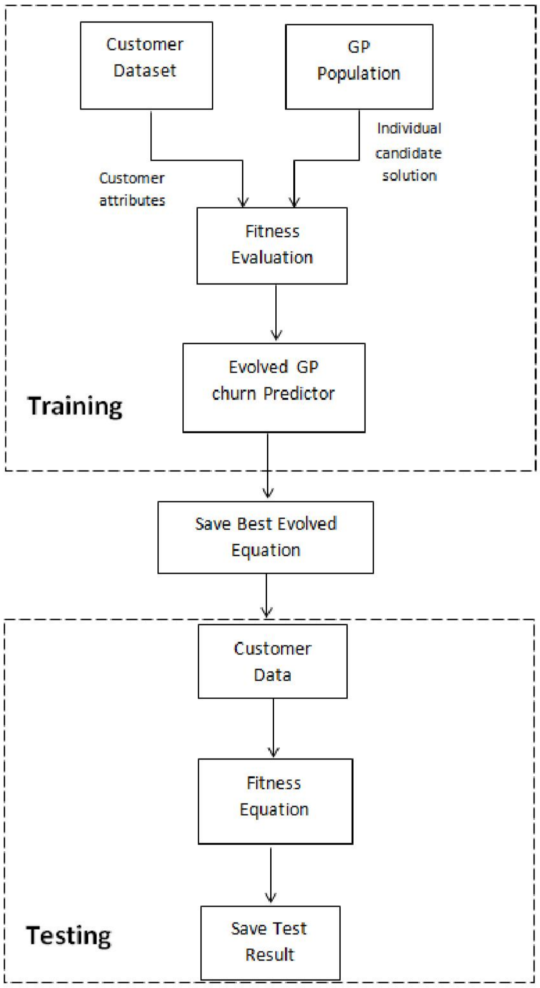

Fig. 2. Research approach

3.1.2 BASIC FUNCTIONS USED FOR GP SIMULATION

Function set in GP is a collection of functions available to the GP system. In our GP simulations, we have used simple functions, including four binary floating arithmetic operators (+, -, *, and protected division), *LOG, EXP, SIN, COS, MAX and MIN*.

3.1.3 TERMINAL USED IN GP SIMULATION

To develop initial population of customer churn prediction the following terminals are used in GP simulation: Age, Paid amount, NET LOCAL CALLS, NWD Call, Local Mobile, NWD Mobile, and OS Calls. Their descriptions can be found in table 1.

3.1.4 FITNESS EVALUATION

In a generation, every individual candidate solution is evaluated and scored using the following algorithm based upon fitness of ith individual in GP population.

For i=1 to N_{cust}
{
If {$fitness_{candidate}$ > 0}
$Churn_{Result}$= 1;
Else
$Churn_{Result}$ =0;
If {$Churn_{Result}$ (XOR) $Churn_{ID}$=1}
$Fitness_i$=1;
Else
$Fitness_i$=0;
Fitness=Fitness+$Fitness_i$;
}
Fitness=Fitness/ N_{cust};

Where, N_{cust} is the total number of customers. $Fitness_{candidate}$ is the evaluation of different customer features on the candidate expression. $Churn_{ID}$ is the actual churn status of a record in the training data. $Fitness_i$ is the fitness of ith record in the training data.

Fitness value corresponding to an individual candidate solution is the mean value computed against the total number of customers in the training data set, and depicts the performance of an individual candidate solution. Likewise, fitness value of every individual in a population is calculated and the process is repeated generation by generation through genetic evolution.

4 EXPERIMENTAL RESULTS

The proposed method is implemented in MATLAB version 7.0. To employ GP, we use the MATLAB-based GPLAB toolbox. In our simulations, we have used Intel Core 2 Duo 2.2 GHz processor with 2 Gb RAM. A total record size for training was 16000 customers. The training data was preprocessed with eliminating records with some missing values. After a best expression is evolved, it took only a fraction of second to make a churning decision in the testing phase.

4.1 ACCURACY VERSUS COMPLEXITY

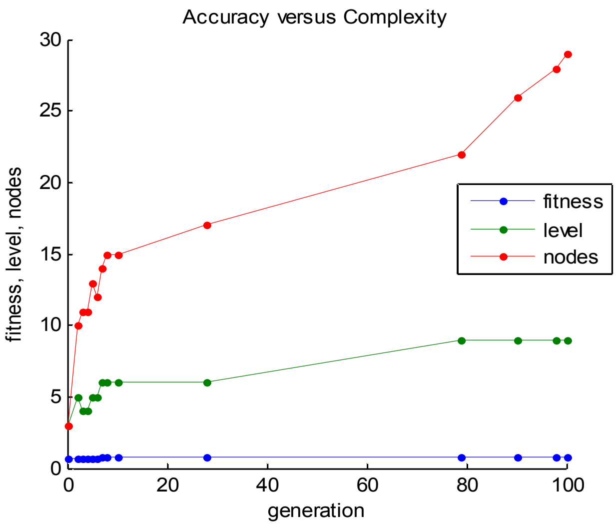

Fig. 3. Accuracy versus complexity produced from the GP simulation.

Accuracy versus complexity plot in figure 3 demonstrates the convergence of the algorithm towards an ideal fitness value of 1. With each generation, the complexity of the evolved GP expression also increases.

4.2 Comparison with other Models

Figure 4 demonstrates the performance comparison of the proposed technique with other state of the art techniques presented in literature.

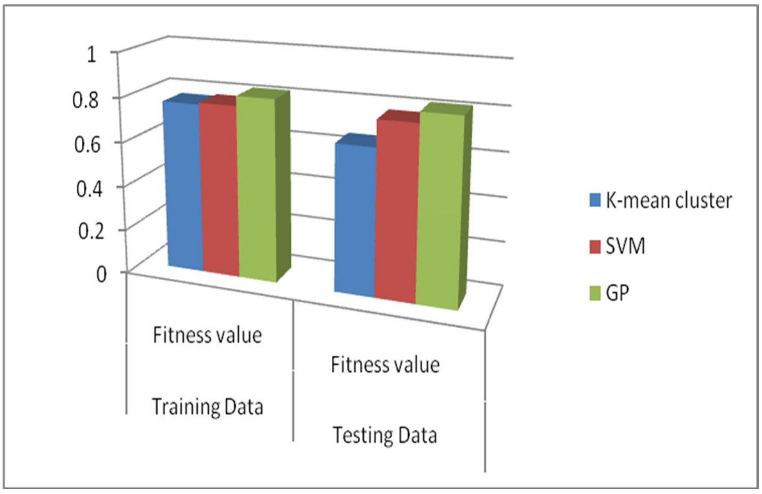

Fig. 4. Comparison of Fitness values of different predictive models

From both training and testing it is cleared from the figure that the result of SVM is much better than K-mean cluster. On similar data, performance of GP based approach is much better than that of other two predictive models.

Figure 5 shows the performance of the proposed technique with other techniques in terms of probability of error. Again we can see the induced error in the proposed technique is much less than SVM and K-mean cluster based approaches.

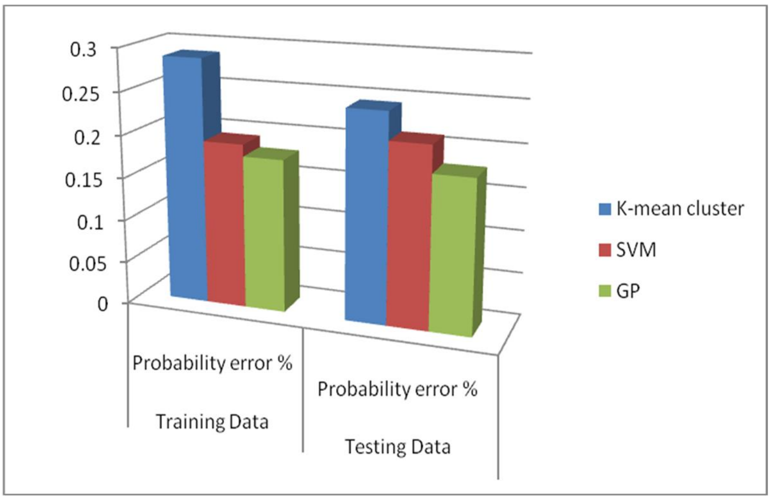

Fig. 5. Probability error percentages for different predictive Models

5 Conclusion

The main objective of this research was to develop a predictive model for customer churn in service based companies which is able to distinguish between customers who are likely to churn in close futures and the ones who are stuck with the company. We used GP based predictive model which outperformed earlier approaches. As the cost of acquiring a new customer is 10 times more than retaining one, thus since the churn predictive model is capable of indicating the future churners, the companies that are intended to maintain their customer base can focus on retention approaches instead of acquisition approaches which is clearly less costly.

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REFERENCES

[1] Seo, D., Ranganathan, C., and Babad, Y., "Two-level model of customer retention in the US mobile telecommunications service market", *Telecommunications Policy*, In Press, 2008.

[2] Hung, S., Yen, D. C., and Wang, H. "Applying data mining to telecom churn management", *Expert Systems with Applications,* 31, 515-524, 2006.

[3] Jadhav, Rahul & Pawar, Usharani, "Churn Prediction in Telecommunication using Data Mining Technology", *IJACSA*, Vol. 2, No. 2, pp. 17-19, 2011.

[4] Timm Euler, "Churn prediction in Telecommunication using MiningMart", In: *Proceedings of the Workshop on Data Mining and Business (DMBiz) at the 9th European Conference on Principles and Practice in Knowledge Discovery in Databases (PKDD),* Porto, Portugal, 2005.

[5] Dejan Radosavljevik, Peter van der Putten, Kim Kyllesbech Larsen, "The Impact of Experimental Setup in Prepaid ChurnPrediction for Mobile Telecommunications: What to Predict, for Whom and Does the Customer Experience Matter?", *Transactions on Machine Learning and Data Mining*, Vol. 3, No. 2 pp. 80-99, 2010.

[6] Chu, B., Tsai, M., and Ho, C., "Toward a hybrid data mining model for customer retention", *Knowledge-Based Systems,* 20, pp. 703-718, 2007.

[7] Luo Bin, Shao Peiji, Liu Juan, "Customer Churn Prediction Based on the Decision Tree in Personal Handyphone System Service", *International Conference on Service Systems & Service Management IEEE*, pp. 1-5, 2007.

[8] Luo Bina, Shao Peijia, Liu Duyu, "Evaluation of three discrete methods on customer churn model based on neuralnetwork and decision tree in PHSS", *First International Symposium on Data, Privacy and E-Commerce, IEEE*, pp. 95-97, 2007.

[9] Javad Basiri, Fattaneh Taghiyareh, Behzad Moshiri, "A Hybrid Approach to Predict Churn", *IEEE Asia-Pacific Services Computing Conference*, pp. 485-491, 2010.

[10] Imran Usman, Asifullah Khan, "BCH coding and intelligent watermark embedding: Employing both frequency and strength selection", *Applied soft computing*, vol. 10, pp. 332-343, 2010.