Non Linear Cellular Automata in Predicting Heart Attack

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Abstract

Non Linear Cellular Automata (NLCA) as a modeling tool has received a considerable attention in recent years. Researchers from different fields have proposed various cellular automata models for addressing several problems in bioinformatics, image processing and network security .In this paper we investigate the computational properties of Non Linear Cellular Automata for building versatile and robust CA data based modeling tool for predicting heart attack.

In this paper, we investigate the non linear classes of Cellular Automata for predicting heart attack. We are mostly interested in computational properties of Non Linear Cellular Automata with decidable features and regularity. We also propose the framework of special class of non linear cellular automata named as Non Linear Multiple Attractor Cellular Automata (NLMACA). This framework is supported with genetic evolution to arrive at the desired local rules of a non linear cellular automata global function. The performances of the proposed classifier were evaluated in terms of training performances and classification accuracies and the results showed that the proposed classifier has good potential in predicting the heart attack.

1. INTRODUCTION

Heart disease [14] is the one killer of men and women in the most of the countries, but many cases are preventable and there are important steps we can take to lower the risk. Recently, the requirement of effective recognition of information- contextual CA is important for decision making, from a huge ensemble of CA has been constantly rising.

Knowledge discovery [1], [2] ,[3] in CAdata bases is well-defined process consisting of several distinct steps. CA clustering is the core step, which results in the discovery of hidden but useful knowledge from massive CAdata bases. CA clustering [4],[5],[6] is the non trivial extraction of implicit previously unknown and potentially useful information about CA. CA clustering technology provides a user-oriented approach to novel and hidden patterns in the CA. The discovered knowledge can be used by the healthcare administrators to improve the quality of service. The discovered knowledge can also be used by the medical practitioners to reduce the number of adverse drug effect, to suggest less expensive therapeutically equivalent alternatives. Anticipating patient's future behavior on the given history is one of the important applications of CA clustering techniques that can be used in health care management. This is an efficient approach for extracting patterns, which are significant to heart attack, from the heart disease CA warehouses.

2. LITERATURE SURVEY

The prediction of Heart disease, Blood Pressure and Sugar with the aid of neural networks was proposed by Niti Guru et al. [22]. Experiments were carried out on a sample CAdata base of patients' records. The Neural Network is tested and trained with 13 input variables such as Age, Blood Pressure, Angiography's report and the like. A set of experiments was performed on a sample CAdata base of 78 patients' records, 13 input variables (Age, Blood Pressure, Angiography's report etc.) are used for training and testing of the Neural Network. The supervised network has been recommended for diagnosis of heart diseases. The System is trained for 78 patients' records. On the basis of this trained CA, when unknown CA is entered by Doctor, the system will find that unknown CA from the trained CA and generate list of possible diseases from which patient can suffer. Training was carried out with the aid of back-propagation algorithm. Whenever unknown CA was fed by the doctor, the system identified the unknown CA from comparisons with the trained CA and generated a list of probable diseases that the patient is vulnerable.

Latha Parthiban et al. [11] proposed a coactive neuro-fuzzy inference system (CANFIS) combined the neural network adaptive capabilities and the fuzzy logic qualitative approach which is then integrated with genetic algorithm to diagnose the presence of the disease. Available CAset of Heart disease from UCI Machine Learning Repository has been studied and preprocessed and cleaned out to prepare it for classification process. Coactive Neuro-fuzzy modeling was a method developed to identify a nonlinear relationship and mapping between the different attributes. Genetic Algorithm useful for auto-tuning of the CANFIS parameters and selection of optimal feature set.

A model Intelligent Heart Disease Prediction System (IHDPS) [9] built with the aid of CA clustering techniques like Decision Trees, Naïve Bayes and Neural Network was proposed by Sellappan Palaniappan et al.. The results illustrated the peculiar strength of each of the methodologies in comprehending the objectives of the specified clustering objectives. IHDPS was capable of answering queries that the conventional decision support systems were not able to. Using medical profiles such as age, sex, blood pressure and blood sugar it can predict the likelihood of patients getting a heart disease. It enables significant knowledge, e.g. patterns, relationships between medical factors related to heart disease, to be established. IHDPS is Web-data based, user-friendly, scalable, reliable and expandable.

K.Srinivas et al. used the potential use of classification data based CA clustering techniques such as Rule data based, Decision tree, Naïve Bayes and Artificial Neural Network to massive volume of healthcare CA. For CA preprocessing and effective decision making One Dependency Augmented Naïve Bayes classifier (ODANB) [49] and naive creedal classifier 2 (NCC2) are used. This is an extension of naïve Bayes to imprecise probabilities that aims at delivering robust classifications also when dealing with small or incomplete CA sets.

A novel heuristic for efficient computation of sparse kernel in SUPANOVA [25] was proposed by Boleslaw Szymanski et al. . It was applied to a benchmark Boston housing market CAset and to socially significant issue of enhancing the detection of heart diseases in the population with the aid of a novel, non-invasive measurement of the heart activities on basis of magnetic field generated by the human heart. 83.7% predictions on the results were

correct thereby outperforming the results obtained through Support Vector Machine and equivalent kernels. The spline kernel yielded equally good results on the benchmark Boston housing market CAset.

3. NON LINEAR CELLULAR AUTOMATA

Since the invention of homogeneous structure of Cellular Automata (CA) , it has been employed for modeling physical systems with diversity. To get better insight of a physical system, in due course, the CA structure is simpli_ed with a restriction to local interactions among the cells . The simpli_ed structure of is an 1- dimensional CA, each cell having two states (0/1) with uniform 3-neighborhood (self, left neighbor and right neighbor) dependencies among the CA cells. It effectively introduces the modularity in a CA structure. Though, in a number of works , it has been shown that the 1-dimensional 3-neighborhood CA exhibit excellent performance while modeling physical systems, it is hard to view that the interacting objects in a dynamical system obey the same local rule (homogeneity) during its evolution. To model such a variety of physical systems, non-homogeneous CA structure (also called hybrid CA) is evolved as an alternative choice. A number of researchers have, therefore, projected their attention to hybrid CA since 1980s and explored the potential design with 1-dimensional hybrid CA specially in V LSI domain.

A detail characterization of hybrid CA and its applications in V LSI domain have been reported in . All such applications are developed around the linear/additive CA structure. However, the linear/additive CA limit the search space for the design while modeling an application with CA. For e_ective modeling of applications from diverse _elds, the nonlinear CA can be a better alternative than the linear/additive CA. However, due to lack of available results on characterization, the nonlinear CA are not considered in V LSI applications as well as in the other _elds. The above scenario motivates us to undertake the research for characterization of nonlinear CA targeting V LSI design and test. We report an explicit characterization of nonlinear CA, with a special attention to V LSI design and test in this chapter. The preliminary version of this characterization has been reported in. The characterization of individual cell rules and the CA as a whole are reported in the subsequent sections. To facilitate such characterization of CA, we include the basics of cellular automata in the following section.

4. IMPLEMENTATION ISSUES

In this chapter we are going to discuss about the implementation issues in detail. We will start this chapter with an example input and corresponding output followed by Sample code for CA preprocessing, K-Means clustering, Frequent pattern clustering, Training, Prediction, implementation issues. In this project Preprocessing, Clustering, Frequent pattern clustering implemented in Java .The classifier is developed in Mat lab.

The below is an examples of input with corresponding output.

If
Male And age < 30 And Smoking = Never And Overweight = No And Alcohol = Never And

Stress = No And High saturated fat diet (hsfd) = No And High salt diet (hsd) = No And Exercise = Normal And Sedentary Lifestyle (Inactivity) = No And Hereditary = No And Bad Cholesterol = Low And Blood Sugar = Normal And Blood Pressure = Normal And Heart Rate= Normal
Or
Male And age > 50 and age < 70 And Smoking = Current And Overweight = No And Alcohol= Past And Stress = No And High saturated fat diet (hsfd) = No And High salt diet (hsd) =Yes And Exercise = High And Sedentary Lifestyle (Inactivity) = No And Hereditary =No And Bad Cholesterol = Low And Blood Sugar = Normal And Blood Pressure = Normal And Heart Rate = Normal
Then

Risk Level = Normal

Otherwise If
Male And Age > 30 and age < 50 And Smoking = Current And Overweight = Yes And Alcohol= Current And Stress = Yes And High saturated fat diet (hsfd) = No And High salt diet (hsd) =Yes And Exercise = High And Sedentary Lifestyle (Inactivity) = Yes And Hereditary = Yes And Bad Cholesterol = High And Blood Sugar = High And Blood Pressure = Low And Heart
Rate = Low Or High

5. EXPERIMENTAL DETAILS

This part of project is implemented in the Java. in this part the significant patterns are minined. The results of our experimental analysis in finding significant patterns for heart attack prediction are presented in this Chapter. With the help of the CAset, the patterns significant to the heart attack prediction are extracted using the approach discussed. The heart disease CA set is pre-processed successfully by removing duplicate records and supplying missing values. The refined heart disease CA set, resultant from pre-processing, is then clustered using K-means algorithm with K value as 2. Then the frequent patterns are mined efficiently from the cluster relevant to heart disease. Subsequently, the significant patterns are extracted with the aid of the significance weightage greater than the pre-defined threshold. The values corresponding to each attribute in the significant patterns are as follows: blood pressure range is greater than 140/90 mm Hg, cholestoral range is greater than 240 mg/dl, maximum heart rate is greater than 100 beats/ minute, abnormal ECG and unstable angina.

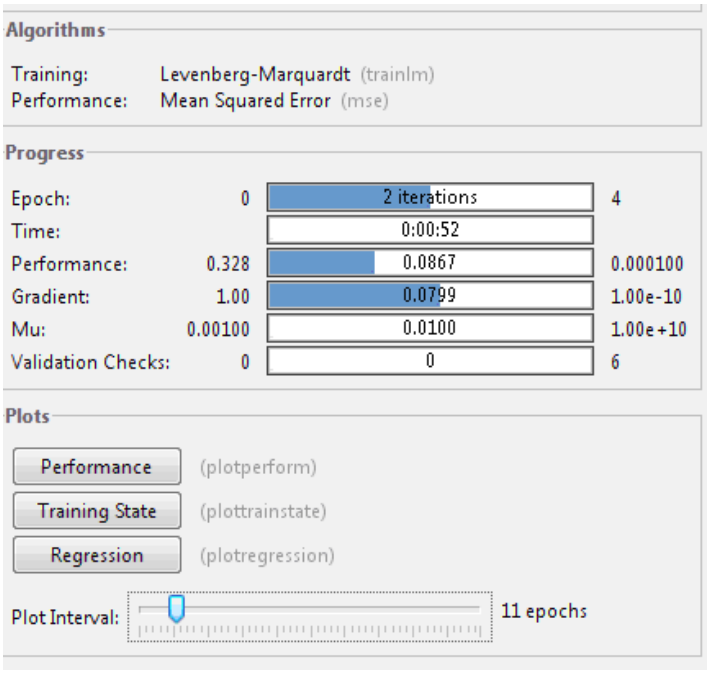

Figure 1.Classifier

In this work, in addition to these significant parameters, we have used some more parameters significant to heart attack with their weightage and the priority levels are advised by the medical experts. The neural network is trained with the selected significant patterns. The designed prediction system employed MLPNN with Back-propagation as training algorithm. With the help of the designed prediction system we can predict the different risk levels of heart attack.

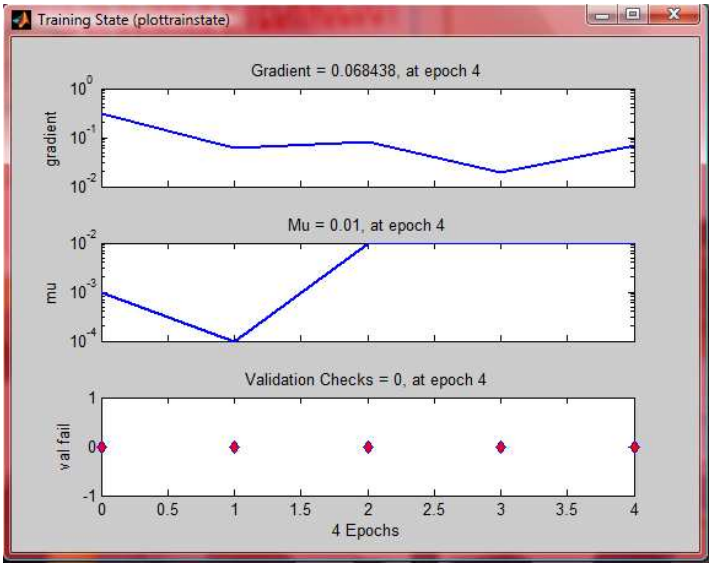

Figure 2. Training

Class path is set to CA Clustering –jar file as shown in Figure 6.1.1 so that we can include this file in my program to deal with CA clustering concepts before this we have to set the class path to jdk1.6.0.

6. CONCLUSION

CA clustering in health care management is not analogous to the other fields due to the reason that the CA existing here are heterogeneous in nature and that a set of ethical, legal, and social limitations apply to private medical information. Most recently, the utilization of knowledge and experience of a variety of specialists and clinical screening CA of patients collected in a CAdata base through out the diagnosis procedure has been extensively recognized. In this thesis, we have presented an intelligent and effective heart attack prediction system using CA clustering and artificial neural network techniques.

We have provided an efficient approach for the extraction of significant patterns from the heart disease CA warehouses for the efficient prediction of heart attack. The preprocessed heart disease CA warehouse was clustered with the K-means clustering algorithm in order to obtain CA most applicable to heart attack. The significant frequent items were mined successfully with the aid of CA clustering. On basis of the calculated significant weightage, the patterns comprising of value greater than a predefined threshold were selected for the prediction of heart attack. The MLPNN have been trained with the selected significant patterns by using Back-propagation training algorithm. The experimental results have illustrated the efficacy of the designed prediction system in predicting the heart attack.

REFERENCES

[1] Sally Jo Cunningham and Geoffrey Holmes, "Developing innovative applications in agriculture using CA clustering", In the Proceedings of the Southeast Asia Regional Computer Confederation Conference, 1999.

[2] Frank Lemke and Johann-Adolf Mueller, "Medical CA analysis using self-organizing CA clustering technologies," Systems Analysis Modelling Simulation, Vol. 43, No. 10, pp: 1399 -1408, 2003.

[3] Tzung-I Tang, Gang Zheng, Yalou Huang, Guangfu Shu, Pengtao Wang, "A Comparative Study of Medical CA Classification Methods Data based on Decision Tree and System Reconstruction Analysis", IEMS, Vol. 4, No. 1, pp. 102-108, June 2005.

[4] Frawley and Piatetsky-Shapiro, Knowledge Discovery in CAdata data bases: An Overview. The AAAI/MIT Press, Menlo Park, C.A, 1996.

[5] Hsinchun Chen, Sherrilynne S. Fuller, Carol Friedman, and William Hersh, "Knowledge Management, CA Clustering, and Text Clustering In Medical Informatics", Chapter 1, eds. Medical Informatics: Knowledge Management And CA Clustering In Biomedicine, New York, Springer, pp. 3-34, 2005.

[6] S Stilou, P D Bamidis, N Maglaveras, C Pappas, “Clustering association rules from clinical CAdata bases: an intelligent diagnostic process in healthcare”, Stud Health Technol Inform 84: Pt 2. 1399-1403, 2001.

[7] T Syeda-Mahmood, F Wang, D Beymer, A Amir, M Richmond, SN Hashmi, "AALIM: Multimodal Clustering for Cardiac Decision Support", Computers in Cardiology, pp. 209-212, Sept. 30 2007-Oct. 3 2007

[8] Anamika Gupta, Naveen Kumar, and Vasudha Bhatnagar, "Analysis of Medical CA using CA Clustering and Formal Concept Analysis", Proceedings Of World Academy Of Science, Engineering And Technology,Vol. 6, June 2005,.
[9] Sellappan Palaniappan, Rafiah Awang, "Intelligent Heart Disease Prediction System Using CA Clustering Techniques", IJCSNS International Journal of Computer Science and Network Security, Vol.8 No.8, August 2008
[10] Andreeva P., M. Dimitrova and A. Gegov, "Information Representation in Cardiological Knowledge Data based System", SAER'06, pp: 23-25 Sept, 2006.
[11] Latha Parthiban and R.Subramanian, "Intelligent Heart Disease Prediction System using CANFIS and Genetic Algorithm", International Journal of Biological, Biomedical and Medical Sciences, Vol. 3, No. 3, 2008
[12] Hian Chye Koh and Gerald Tan, "Data Mining Applications in Healthcare", Journal of healthcare information management, Vol. 19, No. 2, pp. 64-72, 2005.
[13] L. Goodwin, M. VanDyne, S. Lin, S. Talbert, "Data mining issues and opportunities for building nursing knowledge" Journal of Biomedical Informatics, vol. 36, pp: 379-388, 2003.
[14] Heon Gyu Lee, Ki Yong Noh, Keun Ho Ryu, "Mining Biosignal Data: Coronary Artery Disease Diagnosis using Linear and Nonlinear Features of HRV," LNAI 4819: Emerging
Technologies in Knowledge Discovery and Data Mining, pp. 56-66, May 2007.
[15] Cristianini, N., Shawe-Taylor, J. "An introduction to Support Vector Machines", Cambridge University Press, Cambridge, 2000.
[16] Li, W., Han, J., Pei, J., "CMAR: Accurate and Efficient Classification Based on Multiple Association Rules", In: Proc. of 2001 Interna'l Conference on Data Mining. 2001.
[17] Chen, J., Greiner, R., "Comparing Bayesian Network Classifiers", In Proc. of UAI-99, pp.101–108, 1999.
[18] Quinlan, J., "C4.5: Programs for Machine Learning", Morgan Kaufmann, San Mateo 1993.
[19] "Hospitalization for Heart Attack, Stroke, or Congestive Heart Failure among Persons with Diabetes", Special report: 2001 – 2003, New Mexico.
[20] M. Chen, J. Han, and P. S. Yu, "Data Mining: An Overview from Database Perspective", IEEE Trans. Knowl. Dat. Eng., vol: 8, no: 6, pp: 866-883, 1996.
[21] R. Agrawal and R. Srikant, "Fast algorithms for mining association rules in large databases", InProceedings of the 20th International Conference on Very Large Data Bases, Santiago, Chile,August 29-September 1994.
[22] Niti Guru, Anil Dahiya, Navin Rajpal, "Decision Support System for Heart Disease Diagnosis Using Neural Network", Delhi Business Review, Vol. 8, No. 1 (January - June 2007.
[23] Carlos Ordonez, "Improving Heart Disease Prediction Using Constrained Association Rules," Seminar Presentation at University of Tokyo, 2004.
[24] Franck Le Duff, Cristian Munteanb, Marc Cuggiaa, Philippe Mabob, "Predicting Survival Causes After Out of Hospital Cardiac Arrest using Data Mining Method", Studies in health technology and informatics, Vol. 107, No. Pt 2, pp. 1256-9, 2004.
[25] Boleslaw Szymanski, Long Han, Mark Embrechts, Alexander Ross, Karsten Sternickel, Lijuan Zhu, "Using Efficient Supanova Kernel For Heart Disease Diagnosis", proc. ANNIE 06, intelligent engineering systems through artificial neural networks, vol. 16, pp:305-310, 2006.
[26] Agrawal, R., Imielinski, T. and Swami, A, 'Mining association rules between sets of items in large databases', Proc. ACM-SIGMOD Int. Conf. Management of Data (SIGMOD'93),Washington, DC, July, pp.45–51, 1993.
[27] "Heart Disease" from http://chinese-school.netfirms.com/heart-disease-causes.html
[28] "Heart disease" from http://en.wikipedia.org/wiki/Heart_disease.

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