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The Study of Fuzzy Cognitive Maps in Identification and Prediction of Diseases

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Abstract: *Medical diagnosis is an essential problem that is mainly investigated by countless researchers from medical and computer science domains. The aim of medical diagnosis is to recognize whether the patient suffers from a particular disease. Under such hypothesis the medical diagnosis is made with respect to a particular disease, i.e., it is a specific type of classification that assumes only two decision classes, 'Normal' or 'Sick'. It means that for every disease considered by the doctor, a separate diagnosis (classification) with the use of the FCM model should be performed. In this paper, we presented the concepts of Fuzzy Cognitive Map with Decision trees used in the prediction and identification of various disease in health care domain.*
Keywords: *Data Mining, Classification, Decision Trees, Fuzzy Cognitive Map.*

I. INTRODUCTION

With the raise of research and development in biological and medical field, huge amounts of data were formed day by day that needs to be ordered and transformed into appropriate scientific format. A disease is often characterized by a group of genes/proteins which will become active at different stages of the disease. The interaction of these malfunctioning genes forms a complex network with a sequence of genetic activities. Due to its complex and heterogenic nature, these data are not at all well served. These data often require efficient techniques for modeling, storage, analysis and interpretation so that useful information can be extracted. Various algorithms and computational methods have been developed for analyzing protein –protein interaction, cell and molecular level functioning, genetic information, disease prediction, metabolic pathway simulation etc. Similarly a single disease often has a number of causes. If it is possible to identify these disease causing factors, suitable pharmaceutical interventions and effective treatment strategies can be developed. Available methods that convert these heterogeneous data into biological knowledge include neural networks, fuzzy systems, machine learning algorithms and optimization methods such as evolutionary computing, swarm intelligence, immune computing and simulated annealing. Models based on these techniques were used for performing classification, clustering, feature selection and visualization tasks.Existing methods lack stability to integrate different types of biological data. Also all these methods doesn't deal with imprecision and uncertainty which are indispensible in medical and biological data.

Diagnosing the disorder is an important challenge and it requires a cost effective, exact and easy to use system. In order to deal with inaccuracies resulting from uncertainties, astrong firm work is necessary. The learning capacity of neural networks and generalization property of fuzzy logic can be combined to provide more reliable outputs. Fuzzy logic overcomes the difficulties in developing complex system using mathematical models by enabling computational solutions to behave like human reasoning. Fuzziness is often experienced when dealing with naturally vague and complex systems controlled by human observations. The combination of neural networks and fuzzy logic provides a distributed representation of knowledge and has the ability to handle uncertain and imprecise data. The Fuzzy Cognitive Maps(FCM) are an effective soft computing technique that combine fuzzy and neural networks resulting in human-like reasoning by producing dynamic and parallel processing systems that estimate input output functions. The FCM consists of conventional fuzzy system components where computation at each stage is performed by n hidden layer neurons and the system knowledge is enhanced by the learning capacity of neural network.

II. FUZZY COGNITIVE MAP

FUZZY cognitive maps (FCMs) are reasoning networks represented by directed graphs. FCM is described by a directed graph with feedback, which contains a collection of nodes and directed weighted arcs connecting nodes. In FCMs, the nodes represent the concepts. The signed weights associated with the directed arcs represent the types and magnitudes of the causalities between concepts[1]. FCMs are more applicable when the data in its initial state is an unsupervised one. The FCMs work on the opinion of experts. FCM is a simple and effective tool which is used in lots of applications like politics [3], banking [4], medical field [5, 6], sports [7], robotics [8], expert systems [9], etc. A simple FCM is shown in Fig. 1.

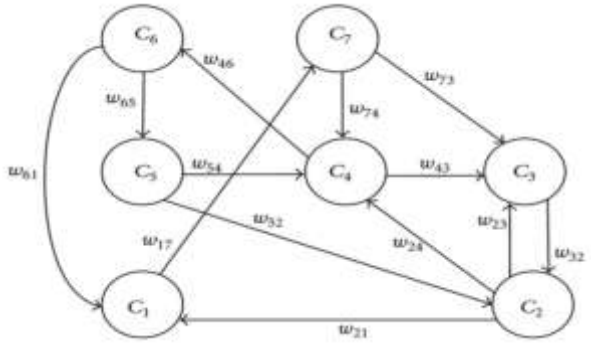

Fig.1: A Simple Fuzzy Cognitive Map

Main aspects of Fuzzy Cognitive Maps

A FCM is a representation of a belief system in a given domain. It comprises of concepts (C) representing key drivers of the system, joined by directional edges of connections (w) representing causal relationships between concepts. Each connection is assigned a weight wij which quantizes the strength of the causal relationship between concepts Ci and Cj [3]. A positive weight indicates an excitatory relationship, i.e. as Ci increases Cj increases while a negative weight indicates an inhibitory relationship, i.e. as Ci increases Cj decreases. In its graphical form, A FCM provides domain knowledge as a collection of "circles" and "arrows" that is relatively easy to visualize and manipulate. Key to the tool is its potential to allow feedback among its nodes, enabling its application in domains that evolve over time. It is particularly suited for use in soft-knowledge domains with a qualitative rather than a quantitative, emphasis. The tool is said to be semi-quantitative, because of the quantification of drivers and links can be interpreted in relative terms only [4]. Fig. 1 shows a fuzzy cognitive map consisting of a number of concepts, some of them are input concepts and the rest are decision (output) concepts, as well as their fuzzy interactions. The main objective of building a fuzzy cognitive map around a problem is to be able to predict the outcome by letting the relevant issues interact with one another.

DECISION TREE

Decision trees is a method used to make decisions based on a set of instances. There are two types of nodes in a decision tree: decision nodes and leaves. Leaves are the terminal nodes of the tree and they specify the ultimate decision of the tree. Decision nodes involve testing a particular attribute. Usually, the test at a decision node compares an attribute value with a constant. Ultimately, to classify an unlabeled instance, the case is routed down the tree according to the values of the attributes tested in successive decision nodes and when a leaf is reached, the instance is classified according to the probability distribution over all classification possibilities.The decision tree is typically constructed by means of a ''divide-and-conquer'' approach. At first an attribute is selected, which is placed at the root node of the tree. This root node splits up and divides the dataset into different subsets, one for every value of the root node. Each value is specified by a branch. Then, the construction of the tree becomes a recursive problem, because the process can be repeated for every branch of the tree. It should be noted that only those instances that actually reach the branch are used for the construction of the tree. Different algorithms can be adopted (C4.5, CHAID, CART) to determine which attribute to split o the given set of examples with different classes.

RELATED WORK

ElpinikiPapageorgiou et.al[12] presented a Fuzzy Cognitive Maps (FCMs) that are an efficient modeling method which providing flexibility on the simulated system's design. They consist of nodes-concepts and weighted edges that connect the nodes and represent the cause and effect relationships among them. The

performance of FCMs is dependent on the initial weight setting and architecture. This shortcoming can be alleviated and the FCM model can be enhanced if a fuzzy rule base (IF-THEN rules) is available. Their research proposes a successful attempt to combine fuzzy cognitive maps with decision tree generators. A combined Decision Tree-Fuzzy Cognitive Map (DT-FCM) model was proposed when different types of input data are available and the behavior of this model is studied. In this research work, they introduced a new hybrid modeling methodology for decision making tasks and they implemented the proposed methodology at a medical problem.

E.I. Papageorgiouet.al[13] presented a model for medical decision making processes (diagnosing, classification, etc.) and all decisions must be made effectively and reliably. Conceptual decision making models with the potential of learning capabilities are more appropriate and suitable for performing such hard tasks. Decision trees are a well known technique, which has been applied in many medical systems to support decisions based on a set of instances. On the other hand, the soft computing technique of Fuzzy Cognitive Maps (FCMs) is an effective decision making technique, which provides high performance with a conceptual representation of gathered knowledge and existing experience. FCMs have been used for medical decision making with emphasis in radiotherapy and classification tasks for bladder tumour grading. This paper proposes and presents an hybrid model derived from the combination and the synergistic application of the above mentioned techniques. The proposed Decision Tree-Fuzzy Cognitive Map model has enhanced operation and effectiveness based on both methods giving better accuracy results in medical decision tasks.

Nan Ma et.al [14] proposed a novel classifier model based on Fuzzy Cognitive Map (FCMCM), he obvious bottleneck of the genetic leaning algorithm used in FCMCM is its irksome efficiency, in particular, low speed in cross over and mutation delay in global convergence. Moreover the lack of the necessary robustness of a single FCMCM limits its generalization. To this end, a quantum computation based ensemble method FCMCM_QC is proposed to address the scalability problem, which employs a novel evolutionary algorithm inspired by quantum computation. The FCMCM_QC effectively uses the concept and principle of quantum computation to facilitate the computational complexity of genetic optimization for the FCMCM and reasonably selects classifiers with better performance for efficient ensembles. The experimental studies demonstrate the quality of the proposed FCMCM_QC in generally used UCI datasets, and the simulation results prove that the FCMCM_QC does enhance the speed of the convergence with high efficiency and good quality.

P.Deepika et.al[15] proposed a method for predicting the Heart disease using Decision tree. They proposed an enhanced decision tree for prediction scheme. The dataset was taken from Cleveland Heart Disease Dataset (CHDD) available on UCI repository . These dataset consists 13 attributes. Their proposed work was implemented using C#.net. The performance of their Enhanced Decision Tree was compared with the performance of C4.5 Decision tree algorithm. Their results showed that the Enhanced Decision Tree model gave better quality assessment.

V.Shankar sowmien et. al[16] proposed a prediction system for liver disease using machine learning. In their work, decision tree was used to determine the structural information of tissues. The algorithm used to construct the decision tree is C4.5 that concentrates on 19 attributes such as age, sex, steroids, antivirals, spleen, fatigue, anorexia, liver big, liver firm, spiders, vilirubin, malaise, varices, ascites, ALK phosphate, SGOT, albumin, protime, and histology for the diagnosis of the disease. They showed 85.81% accuracy while using their proposed system.

III. CONCLUSION

Fuzzy Cognitive maps are widely used for modelling complex real life problems.The entire process of decision making can be done with a graphical structure that can model existing uncertainties. The main objective of this work was to bring out the roles of FCM in disease identification. This paper also focuses the identification and prediction of various disease using decision trees. Fuzzy Cognitive map with Decision Tree is a powerful mechanism that helps to predict the diseases with more accuracy with shortest time.

REFERNCES

[1]. Song, H. J., Miao, C. Y., Wuyts, R., Shen, Z. Q., D'Hondt, M., &Catthoor, F. (2011). An extension to fuzzy cognitive maps for classification and prediction.Fuzzy Systems, IEEE Transactions on, 19(1), 116-135.J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.

[2]. W. B. VasanthaKandasamy and FlorentinSmarandache, "Fuzzy Cognitive Maps and Neutrosophic Cognitive Maps", Book published in 2003.

[3]. Harmanjit Singh Research Scholar, Dr. Gurdev Singh ,Nitin Bhatia,2013,"Fuzzy cognitive maps based election results prediction system" ,International Journal of Computers & Technology Volume 7 No. 1, Council for Innovative Research,pp. 483-492.

[4]. S. M. Reza Nasserzadeh,2008,M. HamedJafarzadeh,TahaMansouri,BabakSohrabi," Customer satisfaction fuzzy cognitive map in banking industry",Volume.2,Communications of the IBIMA.

[5]. Elpiniki I. Papageorgiou, Nikolaos I. Papandrianos, Georgia Karagianni, George C. Kyriazopoulos and Dimitrios Sfyras,2009," A Fuzzy Cognitive Map based tool for prediction of infectious Diseases" FUZZIEEE 2009,Korea.

[6]. Chrysostomos S. Stylios and Voula C. Georgopoulos,2010," Fuzzy Cognitive Maps for Medical Decision Support – A Paradigm from Obstetrics"32nd Annual International Conference of the IEEE EMBS,Buenos, Argentina.
[7]. Gursharan Singh, Nitin Bhatia and Sawtantar Singh,2011," Fuzzy cognitive maps based cricket player evaluator",International Journal of Enterprise Computing and Business Systems, Vol. 1 Issue 2 July 2011.
[8]. Jin-Il Park, Jae-Hoon Cho, Myung-Geun Chun, and Chang-Kyu Song, "Neuro-Fuzzy Rule Generation for Backing up Navigation of Car-like Mobile Robots", International Journal of Fuzzy Systems, Vol. 11, No.3, September 2009.
[9]. Kun Chang Lee and Hyun So0 Kim, "A Causal Knowledge-Driven Inference Engine for Expert System",IEEE,1998.
[10]. Fuzzy inference systems Retrieved Jan 10, 2015 from http://www.cs.princeton.edu/courses/archive/fall07/cos436/HIDDEN/Knapp/fuzzy004.htm
[11]. Classification Retrieved Jan 10,2015 from http://en.wikipedia.org/wiki/Classification
[12]. ElpinikiPapageorgiou, ChrysostomosStylios, Peter Groumpos," A Combined Fuzzy Cognitive Map and Decision Tree Model for Medical Decision Making" 2006 International Conference of the IEEE Engineering in Medicine and Biology Society**,** 30 Aug- 3 Sep, 2006.
[13]. E.I. Papageorgiou, , C.D. Stylios, and P.P. Groumpos," Hybrid model based on Decision Trees and Fuzzy Cognitive Maps for Medical Decision Support System" World Congress on Medical Physics and Biomedical Engineering, IFMBE Proceedings, Volume 6, track 24, 2006.
[14]. Nan Ma, HamidoFujita, Yun Zhai, Shupeng Wang, "Ensembles of Fuzzy Cognitive Map Classifiers Based on Quantum Computation" ActaPolytechnicaHungarica, Volume 12, Issue 4, 2015.
[15]. P.Deepika, Dr.S.Sasikala, S.Saranya, A.Kiruthika," A Noval Clasiification And Prediction Algorithm For Heart Disease Identification" International Journal of Engineering Science Invention (IJESI), Volume 7 Issue 2, 2018.
[16]. V.Shankar sowmien, V.Sugumaran, C.P.Karthikeyan, T.R.Vijayaram, " Diagnosis of Hepatitis using Decision tree algorithm" International Journal of Engineering and Technology (IJET), Volume-8, Issue-3, 2016.
[17]. K.Thenmozhi, P.Deepika, " Heart Disease Prediction Using Classification with Different Decision Tree Techniques" International Journal of Engineering Research and General Science, Volume-2, Issue-6, Pages 6-11, 2014.
[18]. Ms S Saranya, Ms P Deepika, Ms S Sasikala, S Jansi, Ms A Kiruthika, "Accelerating Unique Strategy for Centroid Priming in K-Means Clustering" (International Journal for Innovative Research in Science & Technology), Volume-3, 2016.