

Chapter 9

Hybrid Intelligent Systems for Medical Diagnosis

Rahul Kala

Indian Institute of Information Technology and Management Gwalior, India

Anupam Shukla

Indian Institute of Information Technology and Management Gwalior, India

Ritu Tiwari

Indian Institute of Information Technology and Management Gwalior, India

ABSTRACT

The past few years have seen a lot of applications of Hybrid Soft Computing approaches that seem to have completely replaced the traditional uni-system approaches. The added abilities that come from the hybrid approaches motivate their use in every system. We find various new approaches being applied to the field of Bio-Medical Engineering as well as many new models being proposed. At this juncture, we study the effectiveness of various new hybrid approaches in the field of Bio-medicals. PIMA Indian diabetes database has been used for this purpose from the UCI Machine Learning Repository. The basic aim is to compare the various hybrid approaches from the recent literature and compare their performances. We study 3 major Hybrid Systems and standard Back Propagation Algorithm for this purpose. These are Adaptive Neuro Fuzzy Inference Systems, Ensembles and Evolutionary Artificial Neural Networks. We also try to explain the results from our theoretical understanding of the individual Hybrid Systems.

1. INTRODUCTION

Bio-Medical Engineering is a rapidly growing field as a result of the need and rise of automation. This field calls for the collaboration between the people from the medical background and the engineers to develop intelligent systems for the various tasks

in bio-medicals. These systems are used for the detection of the various diseases. These act as Clinical Decision Support Systems (CDSS) in order to assist the doctors in their task of identification of the presence of the diseases. They hence act as valuable tools for the doctors in the analysis of the diseases. This is especially important considering the work load over the doctors and the vast presence of the diseases. The increasing health conscious-

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ness among the people has further resulted in a lot of emphasis in the development and use of such systems.

Here we make the use of Soft Computing techniques for the detection of diseases. This is essentially a classification problem where the task is to classify the given parameters into either of the two classes that stand for the presence or absence of diseases. A number of inputs or attributes are given to the system to carry out this classification. Suppose these attributes are graphically plotted in a graph with each class being marked with a different symbol. This graph has as many axes as the number of attributes called as the input space. The major task in the problem of classification is to fragment the input space distinctive regions such that each class belongs to some different segment. The boundaries separating the classes are called as decision boundaries. Every system tries to compute or predict these boundaries based on given information or data. The classification problems have always deserved a special mention from the scientific communities as they have their own issues and complexities. One of the most interesting facts with these problems is that despite the revolution in the methods and means of classification, the artificial systems are still far behind the classification powers of humans when compared with accuracies. A related terminology is pattern matching that deals with the ability to recognize any given pattern or set of attributes.

Machine Learning is an exciting field that deals with the learning of the historical data. In most of the problems a lot of data is available from the history. The systems are made to learn this data by the use of training algorithms that may be specific to the system. Learning involves the extraction of rules or patterns from the historic data. It is evident that well trained systems would be able to give correct results to the problems that they have been trained with. Further the time and memory requirement would be reasonably less as the system has already summarized the historic

data into some patterns or rules. Generalization is the ability of the system to give correct outputs to the unknown similar problems. This happens by the application of extracted patterns or rules by the system to the unknown inputs. A system is considered effective if it shows a very high generalizing capability.

Soft Computing is a rapidly growing field that primarily incorporates Artificial Neural Networks, Fuzzy Inference Systems and Evolutionary Algorithms. Artificial Neural Networks (ANN) (Ciampi and Zhang, 2002) are an inspiration from the human brain. The brain consists of a large number of parallel processing elements called as neurons. Each neuron receives the information in the form of electrical signals, processes this information and further transmits the information for the processing of the other neurons. The ANNs consist of numerous artificially designed neurons that work in a layered architecture. Each neuron takes the weighted sum of the incoming information and then passes it by an activation function before giving it to the next neuron. Usually we make use of a 3-layered architecture that consists of a passive input layer, a hidden layer and an output layer. The ANNs form good means of learning from the past data (or machine learning) and generalizing the learnt trends into the unknown inputs. These networks hence undergo two separate stages of training and testing. One of the chief ways of training of the ANNs is Back Propagation Algorithm (BPA). This is a supervised learning model where the outputs must be known for every input while the training is being done. BPA has two separate passes called forward pass and backward pass. The forward pass is a conventional neural network where the inputs are applied and the corresponding outputs are calculated. The difference between the output and the target is calculated which is known as the error. The error is propagated in the backward direction from the output layer to the input layer. Through this all neurons adjust their weights and

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