Soft Computing and Its Various Tools: A Review

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ABSTRACT

Soft Computing as its name implies is an evolutionary approach to produce intelligent system which do have human like expertise. The mind of human is incomparable to anything. Human mind does not work on hard and fast rules i.e. it behaves according to the situation. Soft Computing follows the same approach. It is a breakthrough in science and engineering fields as it can solve problems that have not been to be solved by conventional approaches. It yields rich knowledge which enable intelligent systems to be constructed at low cost. This remarkable idea of producing machines which behave like human minds comes to L.A.Zadeh in 1965 when he proposed the fuzzy sets. After this, enhancement towards this field never stops. These emerging ideas changed the whole world. Today we have microwave ovens and washing machines that can decide how to perform the tasks optimally. The main objective of this paper is to introduce about the latest trends in soft computing as well as hybrid computing to leverage the advantage of two or more than two models.

Keywords

Computational Intelligence, Fuzzy logic, Soft Computing, Neural Networks, Genetic Algorithm.

1. INTRODUCTION

To build the machines which are having human like knowledge intelligence is required. Intelligence basically derives the answer and not simply arrives to the answer. Broadly it is classified into two categories-Artificial Intelligence and Computational Intelligence. Artificial Intelligence techniques are time consuming and complex. Under artificial intelligence we do have hard computing. Today we require low cost and less time consuming solutions to a problem. This can be made possible by Soft Computing. In 1965, L.A.Zadeh started his work of Soft Computing with the initial concept of "Fuzzy Sets". From 1965 to the end of 20th century, true progress on computation with imprecise concepts took place [1].In 1968 he opened up several fields of research by writhing an article on "Probability measures of fuzzy events" [2].After the establishment of BISC (Berkley initiative in Soft Computing) researchers all over the world started work on various tools of Soft Computing. It includes fuzzy logic, Neural Network, Genetic Algorithm, Particle Swarm Optimization and many more [3]. Soft Computing is defined as an approach to construct computationally intelligent systems which have human like expertise and having the ability to adapt and learn in changing environment at low cost. A single computational approach cannot be used to produce these kinds of machines. Therefore, Soft Computing encompasses a group of different methodologies like Fuzzy, Neural, and Genetic Algorithms which have information processing capabilities to solve real-life problems. Soft Computing techniques can tolerate imprecision, uncertainty and partial truth to produce HMIQ (High Machine Intelligent Quotient) [4]. AI techniques deals only with precision, certainty but in contrast with soft computing it exploit the tolerance for imprecision, uncertainty

and partial truth, low solution cost, achieve tractability, error free, and enhanced result with reality. It is used in conjunction with rule-based expert systems in the form of if-then rules. Despite different approaches have been proposed in recent years, for detecting intrusion. Various hybrid method such as neuro-fuzzy, neuro-genetic, fuzzy-genetic, and neuro-fuzzy-genetic are used as most popular techniques [5].These techniques are different from our conventional approach of Hard Computing which are time consuming and complex. Soft Computing is a wide ranging group of techniques like neural network, fuzzy systems, Genetic algorithm and many more. Each of these technologies has their own strength. The main characteristic of soft computing is its capability to create hybrid systems that is based on the integration of various technologies. So, it is called as collection of techniques. This integration provides complementary reasoning methods rather than competitive. Whenever various methods are used to implement a particular machine it is called as Hybrid Soft Computing. Hybrid Soft Computing consists of strength and novelty of two or more computational models. The first and most successful hybrid approach till now are neurofuzzy systems [6], although more hybridations are being developed with great success for example the genetic systems [7].
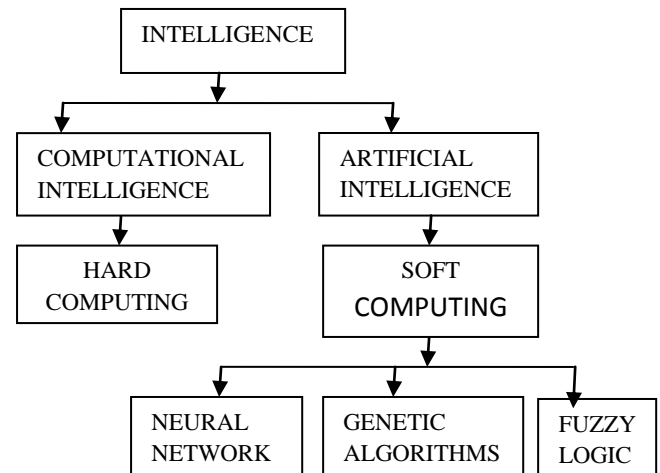

Figure1: Hierarchy of Intelligence

2. ARTIFICIAL NEURAL NETWORK

A continuous approach to mimic the functioning of brain is artificial neural network. An Artificial Neuron is basically an engineering approach of biological neuron. It has device with many inputs and one output. It consists of large number of simple processing elements that are interconnected with each other and layered as well [8][9].Even the brain of animal works so good which a machine cannot follow. Now the researchers are aware that our brain is also in a structured from. Our brain works on neurons. Each neuron is very complicated in structure. They have myriad of parts, sub-systems and control mechanisms. Some pattern is been trying to follow for artificial neural network which can work like human-mind.
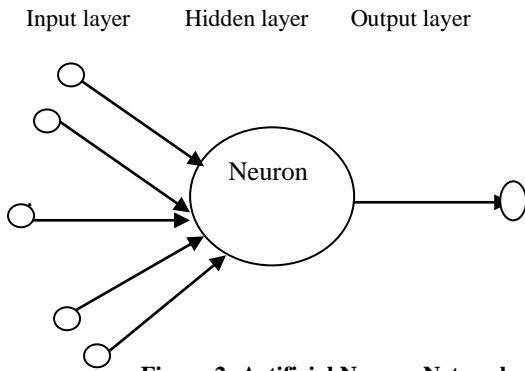
Figure 2: Artificial Neuron Network

The Artificial Neural Network simulates for basic functions of biological neuron as shown in Figure 2[10]:

1.   Input layer
Various inputs can be provided to the system either by input files or directly from electronic sensors in real time functions.

2.   Hidden Layer:
At this step, each of input is multiplied by respective weight factor. After that summation is done on overall inputs. However, many different type of operations can be selected depends upon the requirement. Even we can modify the weights on the input of each processing element as per the need.

3.   Output layer:
The output of this hidden layer is then transferred to the output layer which can change it into the real output according to the devices available.

3. GENETIC ALGORITHMS
The term genetic algorithm abbreviated as GA was first used by John Holland [11] in 1975. Genetic algorithms   are computer programs that mimic the processes of biological evolution in order to solve problems and to model evolutionary system. John Holland presented the theoretical framework for adaptation. It is basically a method for moving from one population of chromosomes to a new generated population using selection together with the genetic inspired operators of crossover, mutation and inversion [12].   It is basically a search technique that will map data for the problems where no particular formula can be implemented.

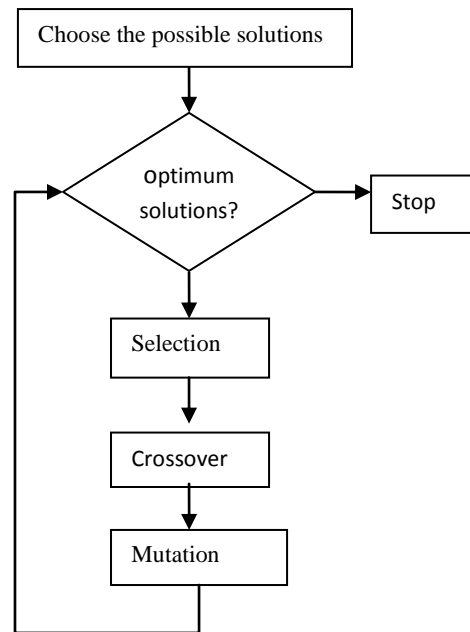The operators followed by genetic algorithm [13] are describes by the flowchart in Figure 3:

Figure 3: Flowchart of Genetic Algorithms

1. Initialization At the first step all solutions to the problem are randomly generated. This is called as population. The size of this depends   upon the type of problem. Basically, all range of possible solutions are considered.

2. Selection In this a good selection method is applied to find out the proportion of the existing population. The selection method we are choosing should be given prime importance because it decides the best possible solutions among the hundreds or thousands of possible solutions.

3. Reproduction This step produces next generation population of solutions from those selected by crossover and mutation. The best fit individuals are selected for reproduction. Then evaluation is done for new individuals. In this way process continues until least-fit population is extracted.

4. Termination The generation process terminates when all the combinations are done or fixed number of combinations has been reached or any other termination condition satisfied.

4. FUZZY LOGIC
The idea of Fuzzy Logic was conceived by Lotfi Zadeh 1965 [1].Basically, Fuzzy Logic (FL) is a multivalued logic, that allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, etc. In a FLS, a rule base is constructed to control the output variable. A fuzzy rule is a simple IF-THEN rule with a condition and a conclusion [14].He gives the concept to make machines smarter and somewhat behaves according to the requirement. Fuzzy Logic also mimics the human brain as Neural Network Do but the concept is different.
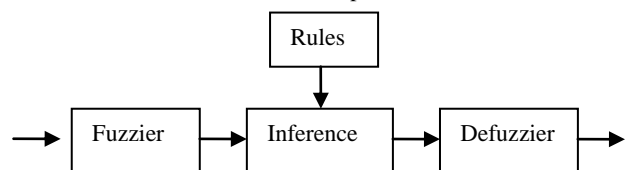

Figure 4: Fuzzy Logic

1. Definition The problem to be solved is defined properly i.e. a basic understanding should be there what has to be done.

2. Using the rule-based structure of Fuzzy Logic, break the problem into series of IF-THEN-ELSE structure that define the desired output with the given inputs.

3. Evaluation and testing is done and more over we can change the inputs for desired results.

5. HYBRID TECHNIQUES

Hybridization of intelligent systems is a promising field of modern intelligence for the development of next generation controllers [16]. Integration of various soft computing techniques can solve complex problems in real world. Hybrid techniques provide more robust and reliable problem solving models than standalone models. Integrating these techniques enhance the overall strengths and lessen weakness thereby helping to solve overall control problem in effective way. Various strategies, models and design have been suggested by researchers to integrate various intelligent systems for practical applications. The main goal of integration is to take the advantages of strengths of each model to achieve effectiveness and efficiency. Hybridization can be done in any manner depends upon the requirement. Neuro-Fuzzy, Genetic-Fuzzy, Neuro-Genetic are the useful techniques for various real time complex problems [16, 17].

6. CONCLUSION

Soft Computing plays a vital role in the development of Intelligent System. In this paper, three methods of Soft Computing have been discussed. The fusion of various techniques has also been presented which can improve performance on real-world applications. This paper concludes that the focus of various researchers moves towards hybrid approach to obtain optimal solutions. Therefore, it is necessary to choose hybrid techniques wisely to egress Intelligent System

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