RESEARCH ARTICLE OPEN ACCESS

A New Approach of Hybrid Architecture Imitating for Human Intelligence

R.S.AbdulMajedRaja[1], A.Mohaideen Fayas Ali[2]
Department of Computer Science and Engineering[1&2],
Government college of Technology,
Coimbatore –Tamil Nadu
India

ABSTRACT

A new approach of hybrid architecture is proposed in this paper which applies various soft computing techniques which imitates human analytical knowledge i.e., it solves problems in human approach. Hybrid intelligence systems deal with the synergistic integration of two or more of the technologies. The combined use of technologies has resulted in effective problem solving in comparison with each technology used individually and exclusively. Real time problems are not single dimensional. It needs to be analyzed in various aspects. Problem solving involves spotting the problem area, decision making, convergence towards the solution. The architecture is designed based on the idea utilizing the divide and conquer strategy. Hybridization exhibits high degree of intelligence and high efficiency is got from divide and conquer strategy. This architecture accurately imitates the human biological decision making.

Keywords:- Genetic algorithms, soft computing, hybridization, neural networks, fuzzy logic.

I. INTRODUCTION

AI is a branch of computer science that is concerned with the automation of intelligent behavior. Creating an artificial intelligence system that has the flexibility, creativity and learning ability of the human biological system is a major goal in artificial intelligence research. The motivation of artificial intelligence starts from brain which is the artificial Intelligence part in our body why because it learns from experience whereas other systems like respiratory system, inherently process the inputs from the birth. Artificial neural networks imitates human biological nervous system. Genetic algorithms imitated human linguistic approach to uncertainty. As the above we have imitated the human way of analyzing and solving a problem.

II. SOFT COMPUTING

Among the various technologies Neural networks, Fuzzy logic and Genetic algorithms are predominantly known as soft computing. The term "SOFT COMPUTING" was first introduced by Lofti A.Zadeh, University of California. Soft computing differs from hard computing in its tolerance to imprecision, uncertainty and partial truth.

Hard computing methods are primarily based on mathematical approaches and demand a high degree of precision and accuracy which can't be got in engineering problems. Employment of soft computing for the solution of machine learning problems has led to high MIQ (Machine Intelligence Quotient).The three components of soft computing differ from one another in more than one way. Soft computing adopts an approach that integrates different methodologies in a synergic fashion to provide a flexible information processing framework as in fig.1 that has application to real world problem

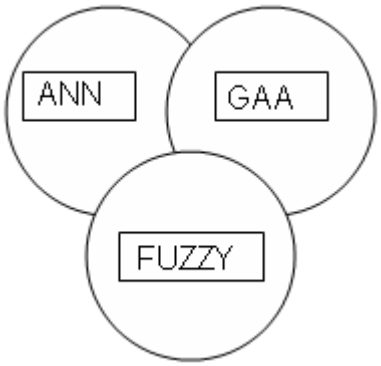
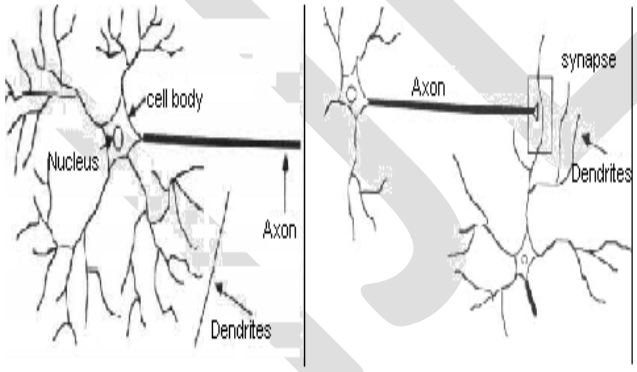


Fig.1: Softcomputing framework

2.1 Artificial Neural Networks

Neural networks which are simplified models of the biological neuron system is a massively distributed processing system made up of highly interconnected neural computing elements that have the ability to learn and thereby acquire knowledge and make it available for use. To capture the essence of biological neural systems, anartificial neuron is defined as follows:



Components of a neuron The Synopses

Fig. 2: Structure of Neuron

- It receives a number of inputs (either from original data, or from the output of other neurons in the neural network). Each input comes via a connection that has a strength (or weight); these weights correspond to synaptic efficacy in a biological neuron. Each neuron also has a single threshold value. The weighted sum of the inputs is formed, and the threshold subtracted, to compose the activation of the neuron (also known as the post-synaptic potential, or PSP, of the neuron).

- The activation signal is passed through an activation function (also known as a transfer function) to produce the output of the neuron.

Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well. Learning typically occurs by example, through training or exposure to a trusted set of input/output data where the training algorithm iteratively adjusts the connection weights (synapses). These connection weights store the knowledge necessary to solve specific problems.

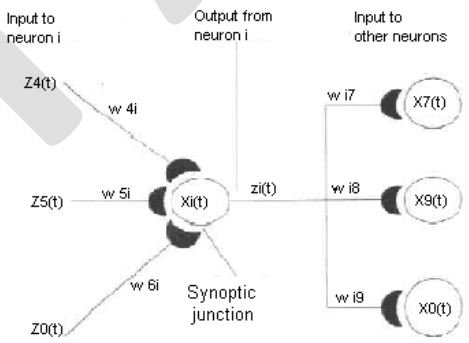


fig. 3: Artificial Neuron

The weights can be negative, which implies that the synapse has an inhibitory rather than excitatory effect on the neuron: inhibitory neurons are found in the brain. Inputs and outputs correspond to sensory and motor nerves such as those coming from the eyes and leading to the hands. However, there also can be hidden neurons that play an internal role in the network. The input, hidden and output neurons

need to be connected together

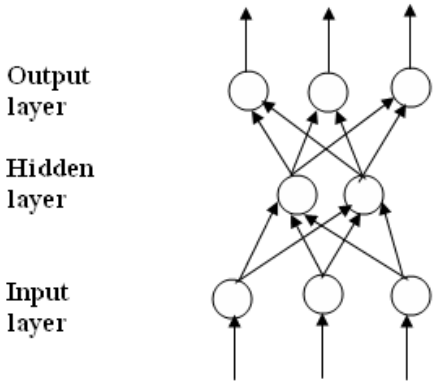
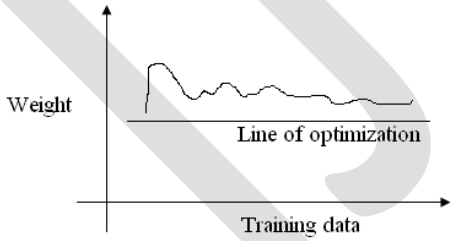


Fig. 4: A typical neural network

2.1.1 Disadvantages:

- Neural networks can compute only numeric data whereas in the real world, that characterizes a system can be both numeric as well as linguistic in nature.
- The conventional weight training algorithm is time consuming.
- Training data set plays an important role in optimizing the weight. If there are intermediate dirty data in training data set, then it will not let the weight converge towards an optimized value.

Consider the following graph



- The semantics of hidden node activation are difficult.
- It is also generally difficult to provide a reasoning mechanism that clearly explains the way the network outputs are generated.
- In addition, much of the human common sense reasoning is based on processing of linguistic concepts. For e.g. simply noting that the cloud cover is dense are dark gray and the wind is strong, we conclude that it is going to rain.
- Real world concepts transition smoothly into another rather than abruptly.

2.2 Genetic Algorithms

Genetic algorithms are computerized search and optimization algorithms based on natural genetics and natural selection [1]. Three important aspects of using GA are

1. Definition of objective function
2. Definition and implementation of gene representation.
3. Definition and implementation of genetic operators.

Genetic algorithms mimic the evolutionary principles and chromosomal processing in natural genetics to seek solutions from a vast search space at reasonable costs. A GA is a iterative procedure, and consists of a constant-size population of individuals. Each individual is represented by a finite array of array of symbols known as string(analogous to chromosome in genetics). Each string is assigned a fitness value derived from a performance measure defined by the criteria to be optimized in the problem at hand .The algorithm starts out with an initial population of individuals that is generated at random. At each evolutionary step, known as generation, the population of solutions is modified to a new population by applying three operators similar to natural genetic operators: reproduction, crossover and mutation.

Reproduction selects good strings; crossover combines good strings to try to generate better offspring's; mutation alters a string locally to attempt to create a better string. The security in applying these operators stems from the fact that if poor quality strings are created by chance, reproduction will eliminate them in next generation.

In each generation, the population is evaluated and tested for termination of the

algorithm. If the termination criterion is not satisfied, the population is operated upon by three GA operators and then re-evaluated. This procedure is continued until the termination criterion is met.

The basic operator applied over the individuals are reproduction, cross over and mutation.

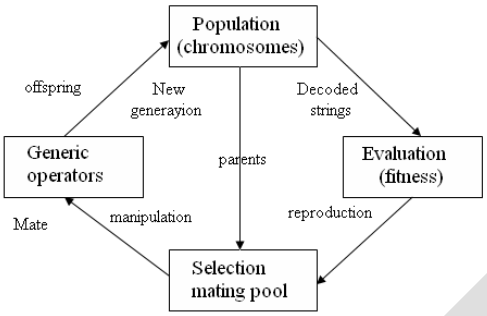


Fig. 5: GA cycle

2.3 Fuzzy Logic

Fuzzy uncertainty stems from imprecision –an elasticity in the meaning of a concept. Real world concepts transition smoothly into one another rather than abruptly. Words are flexible in their meaning in their meaning, and real world information is almost always partial. Human beings are able to deal with this uncertainty because of their ability to put together uncertain and partial facts with their experience into a reasoning framework that is approximate in nature. Our inexact calculus within the brain works with imprecise concepts. Human reason with a fuzzy logic.

Consider the idea of developing a mathematical model for the concept Middle aged. Everyone would almost certainly agree that 40 years old is Middle aged. In other Words, to say that a person is Middle aged is another way of saying that he is around 40 Years old. So let us agree that a 40 year old is middle aged to 100 percent. A 30 years old Person is middle aged to degree 75 percent.

The following table represents a mapping from universe of discourse of ages H, Into degrees of belief that a person aged x years is middle aged. Mathematically, we have The membership of x in the fuzzy set middle aged as

$$\mu_{\text{Middle-aged}}(x): HJ[0,1]$$

AGE	00	10	20	30	40	50	60	70	80
POSSIBILITY	0.00	0.25	0.50	0.75	1.00	0.75	0.50	0.25	0.00

• Uncertainty in the real world can be modeled either through probabilistic means or by using fuzzy sets. The fuzzy sets approach fits in with the linguistic modes of reasoning that are natural to human beings

• A fuzzy set is a mapping from an input universe of discourse into the interval [0,1] that describes the membership of an input variable in the linguistic concept represented by the fuzzy set. Fuzzy sets enjoy a geometrical interpretation: a fuzzy set is a point in the unit hypercube.

• Various operations on fuzzy sets can be defined in a way similar to what we have for classical sets. Fuzzy set is computed using the min operator; fuzzy union using the max operator. The se operators are special cases of more generalized operators
that are called t-norms and t-conforms.

• Other operations on fuzzy set include complement, support, cardinality, core and
Subset to mention a few.

• Fuzzy logic deals with reasoning with fuzzy sets. Fuzzy rules combine multi-antecedent clauses using AND, and multi-consequents using OR .In its simplest form, a fuzzy rule takes the form: if x is A then y is B , where input variable x maps to output variable y using fuzzy sets A,B.

III. MOTIVATION TOWARDS PROPOSED ARCHITECTURE

We are motivated towards the proposed architecture by this logical thinking. The main goal of artificial intelligent system is to adapt to the problem environment. Consider the following case which is well known to us. The student coming from school should be adapted to the Industry environment, after a training

period of four years. The student is considered as natural neural network architecture. The training data here is faculty and text books. Consider the how the particular group of people are selected as faculty from 100 millions of people in world. This is done by applying certain set of procedures. This can be considered as biggest example for optimization. The procedure used for selection can be considered as algorithm (i.e.: genetic algorithms).The same method of optimization is applied to text books. Then the natural neural network is trained in class room for certain period. Then they are tested using sample test data (Question paper)and evaluated and released to environment consider if the student out of college wants to learn the concepts, it will take 5 years for him to select the correct books and another big years for selecting person to teach him and then unknown period may be infinite. This stresses the need for optimization and role of GA in that. In this problem fuzziness will be there in every step, which is dealt using natural human ability to deal with uncertainty.

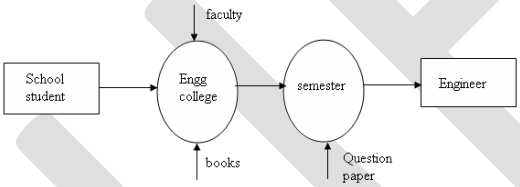
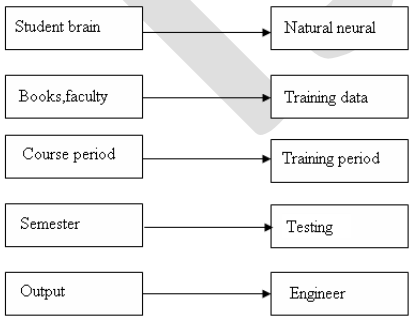


Fig .6: motivation towards the architecture

3.1 Mapping



IV. HYBRIDISATION OF TECHNOLOGIES

Each of the technologies, in their own right and merit has provided efficient solutions to a wide range of problems belonging to different domain. The objective of hybridization has been to overcome the weakness in one technology during its application, with the strengths of the other by appropriately integrating them. Fuzzy logic has its hands in decision making on unclear data. GA can be applied whenever optimization is essential. The greatest demand from Artificial neural system is the adaptation to the problem domain. The artificial neural system has to learn and evaluate from the rough diagram on chart to intelligence system. Learning is one of the problems associated with ANN. It is a time consuming task. The conventional learning algorithm has gradient descent problem i.e., it is more confined to local search space. Learning or training can be viewed as optimization of weight. GA can be applied wherever there is optimization. Weight optimization becomes time consuming and easy. Fuzzy logic can be applied wherever there is a need of uncertain decision making.

V. PROPOSED HYBRID ARCHITECTURE

The proposed hybrid architecture has five units

1. GA based preprocessing unit
2. Problem spotting tree
3. Fuzzy decision maker
4. Solution convergence tree
5. Post processing unit.

5.1 Preprocessing Unit

The preprocessing unit acts as an encoder. The input from the problem domain is encoded using binary encoding or real number encoding as the input to the neural network should be numerical data. GA operators [3] can be applied to evolve the optimized architecture. The functionality is illustrated in the application.

5.2 Problem Spotting Tree

• It is a hierarchical structure following D&C strategy that is it applies the concept of tree.

• It has a root node which acts as a classifier.

• Weight is used here to give equality of input data to be analyzed.

• It classifies the encoded i/p data from preprocessing unit into classes [5] and passes it in to the child.

For e.g.:

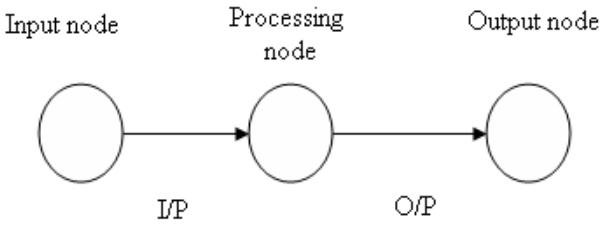
In cricket scorecard analysis, Sachin scoring 45 should be made equal to Nehra scoring 10.

The weight optimization or training is accomplished using the genetic algorithm[7].

5.2.1 The training algorithm

1. Decode each individual in the current generation into a learning rule.
2. Construct a set of ANNs with randomly generated architectures, initial connection weights and train them using the decoded learning rule.
3. Calculate the fitness of each individual (encoded learning rule) according to average training result.
4. Select parents from the current generation according to their fitness
5. Apply such operators to parents to generate offspring which form the new generation.

For this architecture, the population can be got from encoding [4] input node, output node, input data and output data.



Based on these details population is constructed and operators are applied over that.

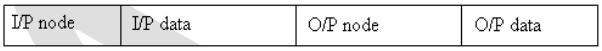
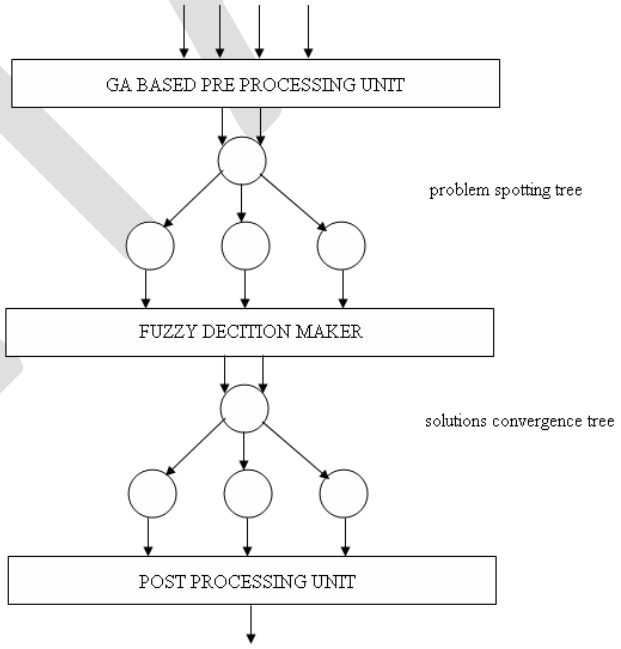


Fig. 6: Encoding of population

5.3 Proposed Hybrid Architecture



5.3.1 Requirement for Tree Structure

Consider how we identify our old friend whom we are seeing after a span of years. Some part of our brain is activated to say that he is someone known to us i.e., the root node. Then it will take to analyze things like height, face cut and some other identification marks parallel at a time. But all these things are done within a very short time and the person is identified. Thus we

employed the same structure behind this task in our architecture.

5.4 Fuzzy Decision Maker

1. The main role of fuzzy decision maker [2] is to act on the uncertainty in the problem.
2. It creates classes based on the problem.
3. It maps every member from input space to the class based on a membership function.
4. Finally it creates a matrix of inputs as rows and classes as columns.
5. After that Fuzzy set operator such as union, intersection are applied both horizontally and vertically.

This acts on the uncertainty and finds the direction to coverage towards the solution.

5.4.1 Solution Mapping Tree

It follows the same structure of problem spotting tree. Based on the results of fuzzy decision maker, it converges towards the solution. It marks the solution spot as 'x' in its leaf node. And that data is fed into post processing unit. This tree is also trained using the same GA proposed above.

5.4.2 Post Processing Unit

It is GA based one. It mainly employs mutation operator. The output of solution mapping tree marks the solution spot i.e., the gene where changes has to be applied to get a better solution. Mutation operator is applied on the dirty bit marked by x. That leads to favorable solution. Another task of this unit is that, it decodes the bits as solution to the environment.

VI. ADVANTAGES

The hybrid architecture

1. Applies tree structure [6], so time complexity will be less.
2. Hybridization imparts highest possible degree of intelligence.
3. Training is done based on GA, which again gives better time complexity.
4. Mapping and classification is done using ANN, which has already proven results.
5. This is just a framework and it can be applied to any specified problem domain.

VII. APPLICATION

The proposed architecture is just a frame work and it can be tuned to fit for any real time application. For e.g. **stock market prediction result analysis and software quality prediction**. We have not stopped just proposing a concept and we have also implemented it for cricket score card analysis problem. In that problem the architecture is used for analyzing the reason for success or failure in the match.

Cricket score card analysis:

Consider the following file score.txt is given as input to the preprocessing unit of this architecture. In preprocessing unit, the scorecard is decoded as

For e.g.

1 Sachin Tendulkar b Warne 45(60)

It is encoded as

Top order(01)	First bat(01)	Runs(01)	Strike rate(01)

In problem spotting tree, root classifies the players based on their first two bits into top order (01), middle order (01), and tail ender (01). While data is passed to the concerned child node, weight value is also multiplied with them. As said above, it is done to equalize the classes. For e.g., Sachin's score of 50 should be equal to Nehra's score of 15. The weight multiplied values of members inside a class is summed up to give as input to fuzzy decision maker where uncertainty is going to be tackled.

In fuzzy decision maker four performance classes are formed match winner, role satisfier, and poor performance due to unfortunate reason and out of form. Thus a matrix is formed for these three classes against the performances classes. Then fuzzy operators such as union and intersection are applied both

horizontally and vertically the matrix. Based on the result of fuzzy decision maker, solution mapping tree finds the solution spot e.g. it may be in the order of a batsman or it may be in the strike rate of a person. Then those positions are marked as x and sent to post processing unit. Mutation operator is applied on that position to get solution to the problem. Then output is decoded to the environment.

7.1 Solution Obtained

```
D:\JAVA\JDK1.3\BIN>javac score.java
D:\JAVA\JDK1.3\BIN>java score
SUGGESTION
Mohammed Kaif can be placed in third position
M.S.Dhoni can be placed in top of tail enders.
the top of tail ender can be replaced with a hitter
cum spinner
THANK YOU
```

VIII. CONCLUSION

The main different between computer & human brain is the later can analyze the problem. Thus we have designed an architecture which imitates the human analytic knowledge. We are sure that is going to be a milestone in AI research through this paper, we are questioning that why the neural architecture alone has to be initiated to exhibit intelligence and why not to imitate the generalization behind the intelligence as a whole Though the real time problem solving is harder to generalize has been achieved through synergizing the soft computing technologies. High level of machine intelligence is achieved through this architecture. Divide and conquer strategy in combination with neural networks accurately imitates biological system. This paper offers a way to model the creative process as a result of ANN's adaptation to dynamic environment.

IX. FUTURE ENHANCEMENTS

We have taken a first step towards atomizing the human analytical knowledge. The difference between human brain and computer is the human's analytical knowledge. This architecture can be considered as a core and components can be constructed around it to build a robot with real human intelligence. Consider the following scenario; robot has eye, ear, mouth and nose. Eye is a video input peripheral. Similarly ear is its audio Counterpart. Mouth and nose are energizing organs. In brain there can be specific architectures to receive and process audio input and similarly the case with video input. The output is given through the microphone. There should be a controlling architecture for these inputs and outputs. Thus it imitates human brain exactly we hope this will be implemented within few years and machine era is going to take birth.

REFERENCES

[1] Goldberg, D.E., 1989. Genetic Algorithms in Search, Optimization, and Machine Learning. Addison-Wesley, New York.

[2] Gopal S., Woodcock C. E., Strahler, A. H., 1999. Fuzzy neural network classification of global land cover from a 1 degree AVHRR data set. Remote Sensing of Environment, 67: 230-243.

[3] Hancock P. J. B., 1992. Genetic algorithms and permutation problems: a comparison of recombination operators for neural net structure specification. Proceedings of the Int. Workshop on Combinations of Genetic Algorithms and Neural Networks (COGANN-92), pp. 108-122. IEEE Computer Society Press, Los Alamitos, CA.

[4] Herrera F., Lozano M., Verdegay J. L., Tackling Real-Coded Genetic Algorithms: Operators and Tools for Behavioural Analysis. NEC Research Index. http://citeseer.nj.nec.com/

[5] Hertz J., Krogh A., Palmer R., 1991. A Introduction to the Theory of Neural Computation. Addison-Wesley, Readings, CA.

[6] Michalewicz Z., 1992. Genetic Algorithms + Data Structures = Evolution Programs. Springer-Verlag, New York.
[7] Yao X., 1999. Evolving artificial neural networks. Proceedings of the IEEE, 87(9): 1423-1447.