

# Blue Brain using Wetware Technology and Fuzzy Logic

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**Keywords**— Human Brain is the most important and valuable creation of God. Human Brain is processor of the body with storage but when the person is dead then the knowledge and intelligence of person also lost with that body, so solution for it to have the artificial brain that can hold the brain content then the knowledge can be preserve after the death of person. Blue brain is the name of the world's first virtual brain. It is a machine that can function as human brain. A genetic-algorithm-based method for tuning the rule base of a fuzzy logic controller is presented. The linguistic structure of the fuzzy logic controller allows a tentative linguistic policy to be used as an initial rule base. Here blue brain using wetware technology is presented.

**Keywords**— *Blue brain, Virtual mind, Fuzzy controller, Artificial brain*

## 1. Introduction

No one has ever understood the complexity of human brain. The ability of a man to control the environment in which he lives is what makes him distinctively different from the other species. Brain is complex than any other circuits in the world. So question may arise, "Is it really possible to create a human brain?" the answer is 'yes'. Because whatever man has created today is, followed the nature. When man does not have a device called computer, it was a big question for all if it is really possible to design a computer. But today it is possible due to technology.

Technology has been progressing to a great extend such that even the human being created artificially through the science of artificial intelligence. Artificial intelligence is the stimulation of intelligence in machines which makes it behave like a human being. It is one of the study and design of intelligent agents where an intelligent agent is a system that perceives its environment and takes actions that maximize its chance of success. All the research followed the nature. Scientists are also following the nature, firstly understanding the natural structure than developing the artificial one. IBM is now in research to create a virtual brain named blue brain. Blue brain is the first artificial brain to be developed. The technology that

works behind the blue brain is called blue brain technology. On 1<sup>st</sup> July 2005, the Brain Mind Institute (BMI) and International Business Machines (IBM) launched the blue brain project.

The aims of this ambitious initiative are to stimulate the brains of mammals with a high level of biological accuracy and ultimately, to study the steps involved in the emergence of biological intelligence. The concept of artificial neural network, fuzzy logic and wetware technology is being used in the creation of the blue brain.

### 1.1 Blue brain

The Blue Brain Project is an attempt to create a synthetic brain by reverse-engineering the mammalian brain down to the molecular level. Data is collected about all the many different neuron types. This data is used to build biologically realistic models of neurons and networks of neurons in the cerebral cortex. The architecture of blue brain is shown in figure 4.

### 1.2 Virtual Brain

Virtual brain is an artificial brain, which does not actually the natural brain, but can act as the natural brain. It can think like brain, take decisions based on the past experience, and response as the natural brain. It is possible by using a super computer, with a huge amount of storage capacity, high processing power and an interface between the human brain and this artificial one.

Through this interface the data stored in the natural brain can be up loaded into the computer. So the knowledge, intelligence of anyone can be kept and used for ever, even after the death of the person. The concept of blue brain is shown in figure 1.

## 2. Artificial Neural Network

In machine learning and cognitive science, artificial neural networks (ANNs) are a family of statistical learning algorithms inspired by biological neural networks (the central nervous systems of animals, in particular the brain) and are used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown.



Fig 1: Concept of blue brain

Artificial neural networks are generally presented as systems of interconnected "neurons" which can compute values from inputs, and are capable of machine learning as well as pattern recognition thanks to their adaptive nature. An artificial neural network structure is shown in figure 2.

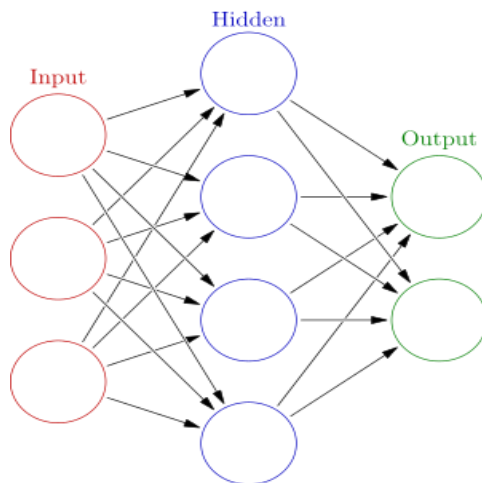


Fig 2: Artificial Neural Network

An artificial neural network is an interconnected group of nodes, akin to the vast network of neurons in a brain. Here, each circular node represents an artificial neuron and an arrow represents a connection from the output of one neuron to the input of another. There is no single formal definition of what an artificial neural network is. However, a class of statistical models may commonly be called "Neural" if they possess the following characteristics:

- i. Consist of sets of adaptive weights, i.e. numerical parameters that are tuned by a learning algorithm.
- ii. Capability of approximating non-linear functions of their inputs.

The adaptive weights are conceptually connection strengths between neurons, which are activated during training and prediction. There are six characteristics of Artificial Neural Network which are basic and important for this technology.

- 1) The Network Structure
- 2) Parallel Processing Ability
- 3) Distributed Memory
- 4) Fault Tolerance Ability
- 5) Collective Solution
- 6) Learning Ability

### 3. The Back propagation

Back propagation requires a known, desired output for each input value in order to calculate the loss function gradient. It is therefore usually considered to be a supervised learning method, although it is also used in some unsupervised networks such as auto encoders. It is a generalization of the delta rule to multi-layered feed forward networks, made possible by using the chain rule to iteratively compute gradients for each layer. Back propagation requires that the activation function used by the artificial neurons (or "nodes") be differentiable. Back propagation, an abbreviation for "backward propagation of errors", is a common method of training artificial neural networks used in conjunction with an optimization such as gradient descent.

### 4. The Wetware Technology

Wetware is a term drawn from the computer-related idea of hardware or software, but applied to biological life forms. Here the prefix "wet" is a reference to the water found in living creatures. Wetware is used to describe the elements equivalent to hardware and software found in a person, namely the central nervous system (CNS) and the human mind. The term wetware finds use both in works of fiction and in scholarly publications. The "hardware" component of wetware concerns the bioelectric and biochemical properties of the CNS, specifically the brain. If the sequence of impulses that traveling across various neurons is thought symbolically as software, then the physical neurons would be the hardware. The amalgamated interaction of this software and hardware is manifested through continuously changing physical connections, and chemical and electrical influences that spread

across the body. The process by which the mind and brain interact to produce the collection of experiences that we define as self-awareness is still seriously in question.

Wetware technology now exists in which a sample of brain cells is put onto a 60 electrode circuit board where the semiconductor should have been. This circuit and the sample on top of it are then, either wirelessly or through the internet, connected to a technological device of various purposes. That device is now alive and has the ability to think, make its own decisions and most amazingly of all, creatively problem solve, which no other technology has ever achieved before.

## 5. Fuzzy Logic

Fuzzy logic is a form of many-valued logic that deals with approximate, rather than fixed and exact reasoning. Compared to traditional binary logic (where variables may take on true or false values), fuzzy logic variables may have a truth value that ranges in degree between 0 and 1. Fuzzy logic has been extended to handle the concept of partial truth, where the truth value may range between completely true and completely false.

### 5.1 Air Conditioners

Old AC's used simple on-off mechanism. When the temperature dropped below a preset level, the AC was turned off. When it rose above a preset level, the AC was turned on. There was a slight gap between the two preset values to avoid high frequency on-off cycling. Example would be "When the temperature rises above 25 C, turn on the unit, and when temperature falls below 20 C, turn off the unit". Using Fuzzy Rules like "If the ambient air is getting warmer, turn the cooling power up a little; if the air is getting chilly, turn the cooling power down moderately" etc. The machine will become smoother as a result of this and give more consistent comfortable room temperatures.

### 5.2 Automatic Gear Transmission System:

It uses several variables like speed, acceleration, throttle opening, rate of change of throttle opening, engine load and assigns a weight to each of these. A Fuzzy aggregate is calculated from these weights and is used to decide whether to shift gears.

### 5.3 Washing Machine:

Sense the load size, detergent amount etc. Keep a track of the water clarity. At start of cycle, the water

will be clean and will allow light to pass through it easily. As the wash cycle proceeds, the water becomes discolored and allows less light to pass through it. This information is used and control decisions are made.

## 6. Work Flow

The work flow of blue brain is shown in figure 3. It collects information from human brain. Then searches in detail about human neurons using software it implements our brain structure. Then the software is developed to involve this information. These information are injected using electrode circuits using wetware technology. Using fuzzy logic the machine can take decisions.

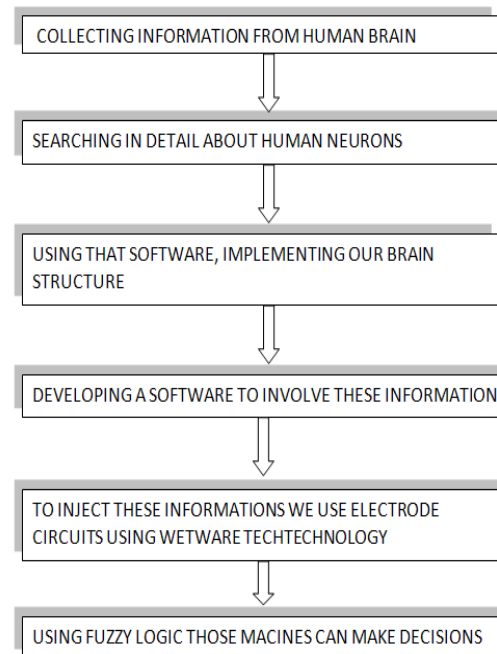


Fig 3: work flow of blue brain

## 7. Genetic Algorithm Based Method

In the design of a fuzzy logic controller, the rules may have multiple input and output variables. However, it has been observed that the majority of the applications in the literature are of the multiple inputs, single output conguration. Therefore, the following method will be introduced assuming that the rule base is of the multi-input single-output type. A rule in the rule base of the system may have the following generic form:

IF  $A_1$  is  $\mu_{n1}(a_1) \diamond A_2$  is  $\mu_{n2}(a_2) \diamond \dots \diamond A_m$  is  $\mu_{nm}(a_m)$  THEN  $B$  is  $\lambda_q(b)$  where  $\diamond$  :a fuzzy logical operator representing AND, OR, etc. (with standard MIN, MAX definitions)  $\mu_{nj}(a_j)$ : fuzzy sets as linguistic

values of  $A_j$  (e.g. PM (positive medium), NB (negative big), etc.)  $n=1, 2, 3, 2, n(j)$  and  $n(j)$  is the number of possible fuzzy sets for the  $j$ th linguistic variable.  $\lambda_q(b)$ : fuzzy sets as linguistic values of output.  $q=1, 2, 2, t$  and  $t$  is the number of possible fuzzy sets for the consequent linguistic variable.

$A_j$ :  $j$ th linguistic variable of the antecedent part of a rule ( $j=1, 2, 2, m$ ).

$B$  : linguistic variable of the consequent part of a rule. When the rule base is given a set of inputs,  $(a_1, a_2, a_3, \dots, a_m)$ , the firing strength  $c_i$  of the  $i$ th rule becomes a result of fuzzy logic function  $\Psi_i$  of the antecedents:

$$c_i = \Psi_i(\mu_{n1}(a_1) \diamond \mu_{n2}(a_2) \diamond \mu_{n3}(a_3) \diamond \dots \diamond \mu_{nm}(a_m))$$

The deterministic output of the fuzzy system is computed by using the *product-operation* inference mechanism and the centroid method as follows:

$$b = \int [\cup_{i=1}^p c_i \lambda_q(b)] b \, db / \int [\cup_{i=1}^p c_i \lambda_q(b)] db, \text{ where } \cup \text{ stands for union (MAX operation).}$$

The inference output of the rule base is a function of several parameters: (a) number of rules, (b) number of fuzzy sets per linguistic variable, (c) membership functions for the fuzzy sets, (d) scaling of the universes of discourse, (e) logical structure, and (f) positioning of the peaks of the linguistic values (fuzzy sets).

In this study, it is assumed that a fuzzy logic controller with its initial rule base and fuzzy sets has been defined. The proposed method tunes the rule base by shifting the peak locations of the fuzzy sets of the system both in the antecedent and the consequent parts of the rules. Then, the number of && tuning parameter is given by

$$d_p = \sum_{j=1}^m s^{(j)} + t$$

where  $s^{(j)}$  and  $t$  are the number of possible fuzzy sets for the  $j$ th linguistic variable and the consequent linguistic variable, respectively.

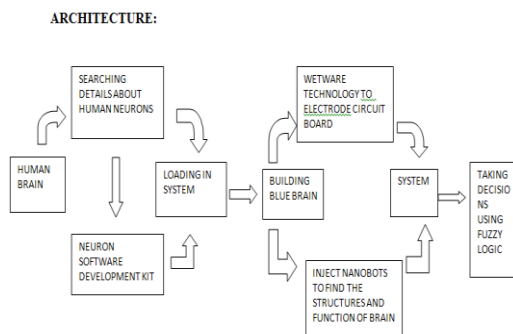


Fig 4: Architecture of Blue brain

## 8. Advantages

- We can remember things without any effort.

- Making decision without the presence of a person is possible.
- We can Use the intelligence of a person after his/her death.
- Understanding the activities of animals is possible.
- Allowing the deaf to hear via direct nerve stimulation is achievable.

## 9. Disadvantage

- We become dependent on the Computer.
- Others may use technical knowledge against us.
- Another fear is found today with respect to human Cloning.
- In addition there seem to be power constraints. The brain consumes about 20W of power whereas supercomputers may use as much as 1MW or an order of 100,000 more (Note: Landauer limit is  $3.5 \times 10^{20}$  op/sec/watt. at room temperature).

## 10. Conclusion

These results are hard to predict. But by using genetic algorithm, it's possible to find a better solution and in turn the decision can be made in a more effective way. Thus with the advancement in technology, the blue brain in future can be implemented better.

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