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The Blue Brain Technology using Machine Learning

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***Abstract*— "Blue brain" is the first virtual brain in the world. It is a computer that functions similarly to the human brain. The Blue Brain Project began developing the neocortical pillar in July 2005 in collaboration with EPFL (Ecole Polytechnique Fdrale de Lausanne), Professor Henry Markram of the Brain Mind Institute, and IBM (International Business Machines). Scientists are currently researching the development of an artificial brain that can think, react, decide and remember something. With technology advances, people should still be retained as the ultimate source of knowledge and exploration. In other words, people don't live for thousands of years, but they could save and use knowledge in their minds for several thousand years. Blue brain is the useful technology in this operation. The key objective is to upload the human brain. It can be used for human society's growth.**

Keywords- Blue brain, Machine Learning, EPFL, Neural Networks, Back Propagation Algorithm, AI;

I. INTRODUCTION

The capacity of a person to regulate his environment is what distinguishes him from the other animals. His analytical abilities placed him at the highest level of the animal kingdom. Therefore, the basic qualities of intelligence lie underlying all human abilities. Intelligence refers to understanding, thinking, acting, interpreting and predicting future relationships, concepts, etc. It helps to make decisions, to solve problem areas, to understand and to reason. Intelligence therefore plays a crucial role in survival and development beyond today.

Blue brain was the first virtual brain in the world. Blue Brain's primary objective is to develop biomedical simulations. This refers to a computer capable of functioning similarly to a human brain. For this purpose, we must upload the human brain into the system. So a computer helps a man think and decide easily. After the body dies, the virtual brain acts like the guy. We apply the reverse engineering phase of the human brain in the virtual brain [1]. Nobody has ever understood human brain complexity. It's complicated than any circuit in the world. Then there might be a question "Can a human brain really be created?" The reply is "Yes." It is possible to upload a human into a device. These robots are sufficiently small to manage the entire circulatory system. Our central nervous system functions and structures can be traced through the spine and brain.

They are capable of communicating at a degree comparable to our minds with computers as long as we maintain our biological structure. Additionally, nanobots will perform a careful scan of our brain's structure to look for similarities. When this data is entered into a machine, the computer immediately starts to operate [2]. This means that the entire contents of the brain are transferred to the machine.

II. CONCEPT OF ARTIFICIAL NEURAL NETWORKS

Every neuron is linked by a connection link to another neuron. Each communication link is associated with a weight with input signal information. This is the most useful knowledge for neurons to solve a particular problem since weight normally stimulates or inhibits the signal. Each neuron's internal state is known as an activation signal. After combining input and activation rules, the produced output signals can be transmitted to other units.

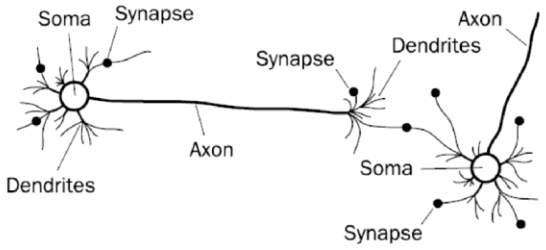

Fig 1: Biological Neural Network

Artificial neural network is a brain model that is highly simplistic [3]. Neurons are considered the building blocks of the neural networks. An artificial neuron is a computer model of a real neuron. Synapses on dendrites or the neuron membrane receive signals from natural neurons. The neuron is triggered and sends a signal at a certain threshold through the axon when the signal is received at a certain level. Each neuron receives entries from a large number of other neurons, modifies its current input status base, and transmits a signal to a large number of additional neurons.

The count and use of ANN forms is very high. Hundreds of different models have been developed as ANNs after McCulloch and Pitts' first neural model (1943). The differences may be functions, agreed values, topology, and algorithms for learning and so on. There are also several hybrid models in which every neuron has more properties than we look at here [4]. Due to spatial issues, we only present an ANN that learns how to use the back propagation algorithm to learn the corresponding weights because It's one of the most popular ANN model based on several others. Since ANNs are intended to process data, they are mainly used in the fields concerned. Numerous ANNs are used to model true neural networks and to study and monitor animal behaviour, but they are also used in engineering for pattern recognition, prediction, and data compression.

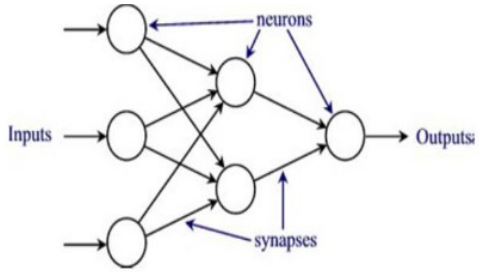

Fig 2: Artificial Neural Networks

A. THE BACKPROPAGATION ALGORITHM

The back propagation algorithm is based on the popular theorem Widrow-Hoff. The algorithm uses supervised learning which involves examples of network inputs and outputs and then calculates the error. Random weights begin with the background propagation algorithm, which is designed to adjust them before the ANN learns the training data, to minimise the error [5]. The basic backpack algorithm is a gradient descent algorithm that modifies the network weights and output gradient in a negative manner. The combination of weights that reduce the error function is considered a solution to the learning problem. The back propagation algorithm includes a differentiating activation function, with tan-sigmoid, log-sigmoid, and sometimes linear. One or more secret neuron layers and a linear neuron output layer comprise feedback networks. Between the input and output vectors, the network can discover both nonlinear and linear relationships. The network's linear output layer enables it to run in the +1 to -1 range.

The training data sets, which are used to measure error gradients and to change weights, and the confirmation data sets, to select the optimal number of iterations in order to prevent overlearning [6], must be divided into two sets for the learning process. If the number of iterations increases, the exercise error falls, while the error in the validation data set falls, then hits minimum and eventually increases. After a validation mistake, the continuation of the learning process leads to overlearning. If the learning process has been completed, another data collection (test set) is used to verify the prediction accurately. Properly trained backprop networks are designed to provide logical answers to new inputs.

In ANN approaches, data normalisation is usually required before the training phase starts to ensure that the effect of the input variable during model building does not depend on the extent or range of its original values [7]. The standardisation process typically involves a linear transformation of the input/output variables into the range (0, 1).

It is important to reduce the error values in randomly assigned weights and biases to generate the correct output behind the back propagation algorithm [8]. The system is trained in the supervised learning method where the system is faced with an error between the output and the known predicted output to change its internal status. We need to update the weights to minimise global loss. This is how neural network propagation works.

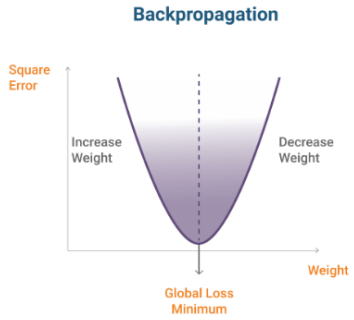

Fig3: Back propagation Algorithm

B. THE WETWARE TECHNOLOGY

While the word "wetware" is derived from the concept of a hardware or software device, it is used to refer to biological aspects of life. The prefix "wet" denotes the presence of water within living organisms. Wetware is a term referring to the hardware and software components of the central nervous system(CNS) and human mind.

Wetware's "hardware" component is concerned with the central nervous system's biological and biochemical properties, especially the brain. The individual neurons are called hardware if the sequence of impulses going through the different neurons is software. Physical interactions and chemical and electrical forces in the body are constantly changing, demonstrating the interaction between software and hardware.

A wetware machine is one that is completely made of living neurons [9]. The development of these synthetic yet organic brains is the responsibility of Professor Bill Ditto, the main researcher at the Georgia Institute of Technology. A leech neuron prototype is capable of performing basic arithmetic procedures. While the principles are still being studied and prototyped, synthetic organic brains should soon be able to recognize basic patterns such as handwriting, but in a much simplified form than animal brains.

Wetware technology is now available, which involves the placement of a sample of brain cells on a 60-circuit board intended for use as a semi-driver [10]. This circuit and the example above it are connected to a variety of different types of technical computers, either wirelessly or over the internet. This computer is now conscious and capable of reasoning, making its own choices, and, most remarkably, creating a challenge that no other technology has ever solved.

The brain cell sample is grown on the circuit board and adapts to the new body by changing neuronal and electrical pathways. Indeed, scientists now see a brain expanding and evolving in real time, which sheds new light on how our brains function and how we heal. This technology would also provide insights into decades of mental illness, to revolutionise our view of machinery and unmanned devices.

Wetware is just the interface of the actual neurons to the artificial neurons. A "Neuron" app is the blue brain wetware. It was also proposed that people could buy their own living technology in ten years' time.

C. *FUZZY LOGIC*

Fuzzy logic is characterised as a multi-value logic, which can have actual variables values between 0 and 1 in any real number. It's the partial truth principle. We can find in real life a situation in which we cannot decide if the statement is right or wrong. Fuzzy logic offered very useful reasoning versatility at that time.

Fuzzy logic algorithm [11] helps to solve a problem by taking all available data into account. The best choice is then made for the input. The FL process imitates how a person decides to take all possibilities between the digital T and F values into consideration.

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D. *Fuzzy Logic Architecture*

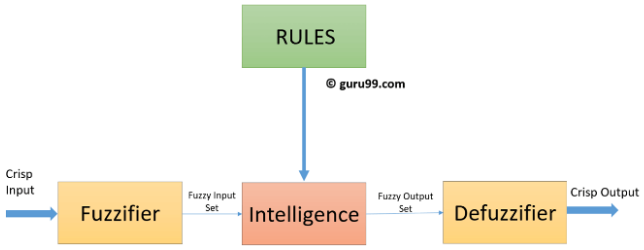

Fig 4: Fuzzy Logic Architecture

Rule Base: It includes all the instructions and the requirements for the experts to monitor the decision-making process. The latest update on Fuzzy Theory provides Fuzzy controllers with different design and tuning methods [12]. This change reduces the number of fugitive laws substantially.

Fuzzification: The fluzzification stage allows inputs to be converted. The crisp numbers can be converted into fuzzy sets. Crisp inputs were calculated by sensors and transferred for further processing to the control system. Pressure, etc., like room temperature.

Inference Engine: It helps you to evaluate to what degree the fluffy feedback and rules match. Based on the percentage stage, it determines which rules the region must apply. The laws are then merged in order to establish the control steps.

Defuzzification: Finally, the disfusion method is used to transform the fuzzy sets into a narrow value. There are several different types of methods, so you have to pick the ones are suitable for an expert programme.

The way people think is inherently smooth. The way we see the world is evolving continuously and cannot in false or real claims be reflected. Take all apple and apple kernels around the world. Now take one of these apples; it is included in every apple package [13]. Take a dick from the apple, it's still the right apple? If so, it's still part of the apple collection. You have left an apple core and it belongs after several other bites to the box of apple cores. How much did the apple go from the apple to the heart of the apple? What if you could get a bite out of the middle of the apple, would you move it to another set?

A fuzzy selection helps its members gain credentials for membership. If value 1 is allocated entirely to objects in the set and the value of 0 is allocated to objects outside of the set, every object in the set is 0-1. The number assigned to the object is its collection membership. An apple with a single bite that is 0.9 in the apple set. This does not mean that the Apple Cores kit needs a membership level of 0.1. If the apple is eaten, however, it becomes a part of the fluffy array of apples and a fluffy selection of apple cores.

The mechanism is the regulated system that cannot normally be modified. Then the controller must take the input and

determine the method as well. The decision is taken from the perspective of the past.

III. THE BLUE BRAIN

The analysis includes the study of sections of living brain tissue by microscopes and electrodes in patches. All the many forms of different neurons are collected. These data are used to create biologically accurate neuronal models and neuronal networks in the brain cortex. The simulations are performed on an IBM-built Blue Gene supercomputer. This is why the name is "Blue Brain." Michael Hines and the other custom components use the NEURON simulation software [14]. The project aims to gain full understanding of the brain and to increase and speed up the development of treatments for brain disease.

The success of mind uploading is still dubious to typical scientists, impending researchers and science journalists. Important mainstream research is performed in the animal brains to compare, contrast and simulate, build quicker supercomputers.

Sensitivity is a normal part of the climate. We believe that understanding relies on the laws of physics and chemistry and biology, mathematics and logic [15]. This mechanical understanding of the mind is focused on the concept of uploading the mind. Such an intelligence capability may provide the requisite computer substratum for uploading.

A. NEED OF AN ARTIFICIAL BRAIN

Today, we are the source of our wisdom. Intelligence is an innate, uncreated characteristic. Certain individuals possess this trait, rendering others incapable of thinking. Such wisdom and intelligent brain are still essential in human society. But after death, intelligence and the body are lost. The virtual brain solves this problem. And after death, brain and intelligence will be alive. We also have problems recalling items such as names of individuals, birthdays and word orthography, the right pronunciation, significant dates, history details and so on. Everyone needs to rest in the busy life. A better alternative would be the virtual brain.

B. POSSIBILITIES OF ARTIFICIAL BRAIN

It is useful to explain the simple ways an individual can be uploaded to a machine. Recently Raymond Kurzweil gave an interesting paper on the subject. It defines invasive as well as non-invasive techniques. Very small robots or nanobots are the most promising. These robots are tiny enough to fly through all of our circulatory systems. To track the function and structure of our central nervous system, you move to the spine and brain. You should strive to obtain a computer interface as soon as possible while we are still biological. Nanobots may also perform a detailed scan of our brain structure and read the association of each neuron. Additionally, they document the brain's current state. And, when you meet a machine, this experience operates similarly to ours. What you need is a room- and computer-rich computer. Many people assume that we are alive, and quantity forces contribute to our consciousness. But now we must logically remember.

C. BUILDING A BLUE BRAIN

The following measures are included:

Step 1: Data Collection

The microscope and the shape and the electrical behaviour of each neuron are the part of the brain. This is a well-established, globally recognized approach to neuron analysis and catalogue. Neurons are categorized based on structural properties. The findings are translated into accurate algorithms describing the mechanism, purpose and position of the neuron. The algorithms are then used to produce biologically plausible and simulated virtual neurons.

Step 2: Data Simulation

The simulation stage entails the generation of virtual neurons using real-neuron algorithms. The algorithms and parameters of the simulated animal are calibrated according to age, species and disease. Each protein is simulated and approximately one billion are in one cell. For each synthesized neuron, an initial network skeleton is created. The cells are then bound according to the laws observed experimentally. The neurons are now in good health, and the simulation has been restored. Emerging behavioural patterns are visualized using the given resources.

D. BLUE BRAIN SOFTWARE DEVELOPMENT KIT

The Blue Brain SDK is a Java/Python wrapped C++ library. NEURON is the current neural simulation application. This software models neuronal cells across different ion channels by modelling ion streams in and out of the cell. These movements create an electric potential differential between the inside and outside of the neuronal membrane and enable different neurons to communicate. This was founded in the early 1990s by Michael Hines of Yale and John Moore of Duke University. Open source software is freely available. The Web site provides free access to anything including code and binary data. In 2005 Michael Hines carried the kit into the vast parallel Blue Gene in collaboration with the BBP team.

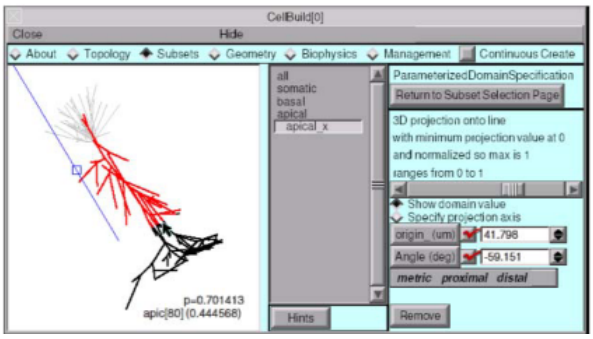

Fig 5: NEURON cell binder window

IV. VISUALIZATION

The Blue Brain Project's primary application for visualizing neural simulations is RT Neuron. This software was developed internally by the BBP team. C++ and OpenGL are password-protected. RT Neuron is a custom software created for neural simulations that is not applicable to other simulations. RT Neuron may use Huxley's output from the Hodgkin simulation as the input to NEURON in order to deliver it in 3D. This enables programmers and scientists to visualize the propagation of the activation potential between or around neurons. Researchers can communicate with the model by pausing, restarting, and zooming in on the animations. The views include several dimensions. Commodity PC clusters were used to visualize the RT Neuron machine.

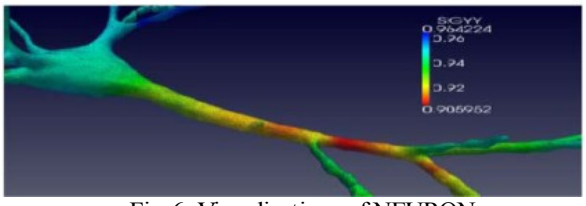

Fig 6: Visualization of NEURON

V. HARDWARES /COMPUTERS USED

- A great machine.
- Memory with a very wide storage space.
- Very high power processor.
- A rather wide network.
- A programme for converting the brain electrical impulses to the input signal obtained on the screen, and vice versa.
- Very strong nanobots to connect the natural brain with the machine

Blue Gene/P

The Blue Brain Project's main machine is IBM's Blue Gene supercomputer. The word "Blue Brain" comes from here. In June 2005, IBM agreed to supply Blue Gene/L to EPFL as 'technology proof' The contract terms were not disclosed in the IBM press release.

Fig.6 Blue Gene/P Supercomputer

JuQUEEN

JuQUEEN is a supercomputer developed in May 2012 for IBM Blue Gene/Q at the German Jlich Research Center. At 1.6 petaops, in June 2012, it was the world's 8th fastest supercomputer. If funding is obtained from the Human Brain Project, this computer could be used to simulate BBP in 2013. Additionally, the JuQUEEN machine is used in the JuBrain research project (Jlich Brain Model). This is used to create a three-dimensional model of a realistic brain.

Fig.7 JuQUEEN Supercomputer

DEEP- Dynamical Exascale Entry Platform

DEEP has been established at the Jlich Research Center in Germany as an exascale supercomputer. The project's three-year prototype phase earned 8.5 million. A supercomputer prototype will be designed by the end of 2014 at 100 pet flops.

The simulations of the Blue Brain Project are transferred to the DEEP prototype to test the results of the device. A future exascal version of this computer could provide a complete simulation of the human brain for the 1 expected performance exaflops in the 2020s.

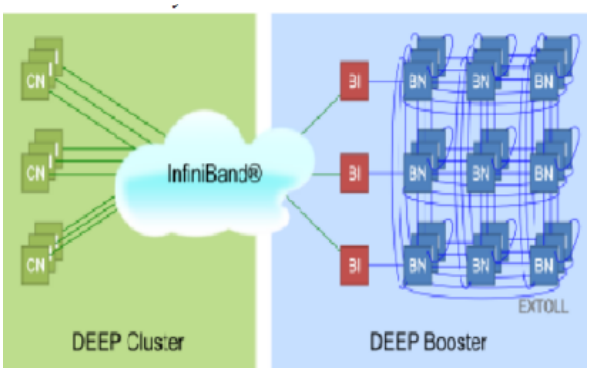

Fig.8 DEEP Supercomputer

ADVANTAGES:

- Without effort, we can recall stuff.
- Decisions may be taken without a person's presence.
- His wisdom can be used well after a man's death.
- The behaviour of various animals is understandable. That means that their reasoning can be easily understood by interpreting the electrical impulses from the animals' brains.

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DISADVANTAGES:

- We are reliant on computer systems.
- Others can use against us technical knowledge.
- Computer viruses are becoming more and more important.
- However, the real challenge is the fear of people having new technology. This fear can lead to widespread resistance. There is clear evidence of this kind of concern today about human cloning

VI. CONCLUSION

We think the time has come to start assimilating the wealth of data collected in the last century and to construct biologically realistic brain models from initial concepts, which will help us to grasp the role and malfunction of our brains. In conclusion, at some stage we should switch to machines. The majority of claims against this result seem to be easy to bypass. Either you are simple-minded or take additional time to upgrade technology. Additionally, the only significant risks associated with the integration of biological and digital technologies are addressed. By 2017, we anticipate that the interaction between the Blue Brain and Soul Catcher will transcend human intellectual capability, and that by 2050, we will be able to download a human being's mind.

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