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The Blue Brain Technology Using Wetware Technology and Fuzzy Logic

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***Abstract*— " Blue brain " is the name of the world's first virtual brain. It is a machine that can function as human brain.The Blue Brain Project began in July 2005 as a collaboration between Professor Henry Markram from the Brain Mind Institute at the EPFL (Ecole Polytechnique Fdrale de Lausanne) and IBM (International Business Machines), aimed at modelling the neocortical column. Today scientists are in research to create an artificial brain that can think, response, take decision, and keep anything in memory. With the advancement in technology, human, the ultimate source of information and discovery should also be preserved. In other words, human is does not live for thousands of years but the information in his mind could be saved and used for several thousands of years. The technology helpful in this activity is Blue Brain.The main aim is to upload human brain into machine.It can be used for the development of the human society.**

***Keywords*—blue brain, artificial neurons, wetware, fuzzy logic, perceptron, backpropagation**

I. INTRODUCTION

The ability of a man to control the environment in which he lives is what makes him distinctively different from the other species. His intellectual skills place him at the most superior level of the animal kingdom. Thus, underlying all human abilities lie the essential attributes of intelligence. Intelligence refers to the ability to understand, think, act, interpret and predict the future to achieve and handle relationships, concepts etc. It helps in decision making, problem solving, learning and reasoning. Intelligence thus plays a very important role in survival and progress beyond the present.

Technology has been progressing to a great extend such that even the human brains are being created artificially through the science of artificial intelligence. Artificial intelligence is the simulation of intelligence in machines which makes it behave like a human being. It is the study and design of intelligent agents where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.

Blue brain in the first artificial brain to be developed. The technology that works behind the blue brain is called the blue brain technology. The blue brain is created using the artificial neural network . On 1 July 2005, the Brain Mind Institute (BMI, at the Ecole Polytechnique Fidrale de Lausanne) and IBM (International Business Machines) launched the Blue Brain Project. The aims of this ambitious initiative are to simulate 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 Blue Brain Project plans to reverse engineer the human brain as a supercomputer simulation. It is hoped that a rat brain neocortical simulation (21 million neurons) will be achieved by the end of 2014. A full human brain simulation (86 billion neurons) should be possible by 2023 provided sufficient funding is received. Researchers want to use this technology to develop new therapies for the brain diseases and also new computer technologies. The concept of artificial neural network, fuzzy logic and the wetware technology is being used in the creation of the blue brain.

II. ARTIFICIAL NEURAL NETWORK

Artificial neural network is an extremely simplified model of the brain. The building blocks of the neural networks are called the neurons. An artificial neuron is a computational model inspired in the natural neurons. Natural neurons receive signals through synapses located on the dendrites or membrane of the neuron. When the signals received are strong enough ,surpass a certain threshold , the neuron is activated and emits a signal though the axon. This signal might be sent to another synapse, and might activate other neurons.Each neuron receives inputs from many other neurons, changes its state base on the current input and send one output signal to many other neurons.

The complexity of real neurons is highly abstracted when modelling artificial neurons. These basically consist of inputs (like synapses), which are multiplied by weights (strength of the respective signals), and then computed by a mathematical function which determines the activation of the neuron. Another function computes the output of the artificial neuron. ANNs combine artificial neurons in order to process information.

Information is transmitted as a series of electric impulses, so-called spikes. The frequency and phase of these spikes encodes the information. In biological systems, one neuron can be connected to as many as 10,000 other neurons. Usually, a neuron receives its information from other neurons in a confined area, its so-called receptive field.

The higher a weight of an artificial neuron is, the stronger the input which is multiplied by it will be. Weights can also be negative, so we can say that the signal is inhibited by the negative weight. Depending on the weights, the computation of the neuron will be different. By adjusting the weights of an artificial neuron we can obtain the output we want for specific inputs. But when we have an ANN of hundreds or thousands of neurons, it would be quite complicated to find by hand all the necessary weights. But we can find algorithms which can adjust the weights of the ANN in order to obtain the desired output from the network. This process of adjusting the weights is called learning or training.

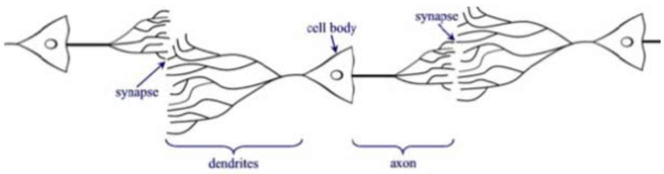

Fig.1 Biological Neural Network

The number of types of ANNs and their uses is very high. Since the first neural model by McCulloch and Pitts (1943) there have been developed hundreds of different models considered as ANNs. The differences in them might be the functions, the accepted values, the topology, the learning algorithms, etc. Also there are many hybrid models where each neuron has more properties than the ones we are reviewing here. Because of matters of space, we will present only an ANN which learns using the backpropagation algorithm for learning the appropriate weights, since it is one of the most common models used in ANNs, and many others are based on it. Since the function of ANNs is to process information, they are used mainly in fields related with it. There are a wide variety of ANNs that are used to model real neural networks, and study behaviour and control in animals and machines, but also there are ANNs which are used for engineering purposes, such as pattern recognition, forecasting, and data compression.

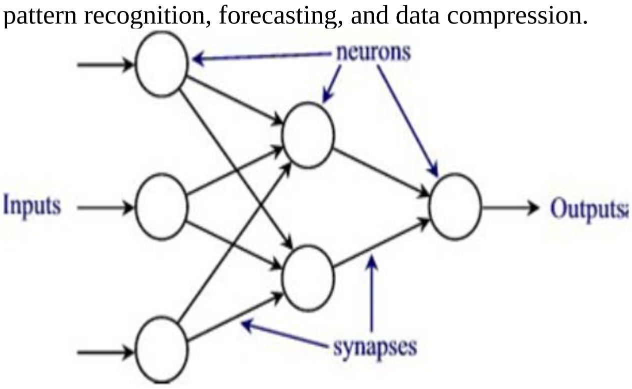

Fig.2 Artificial Neural Network

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

III. PERCEPTRON

Perceptron is the basic unit of the neural network. A perceptron takes a vector of a real valued input , calculates a linear combination of these inputs, and outputs a 1 if the result is greater than some threshold and outputs a -1 if the result is lesser than the threshold. it consists of:

• N inputs, X_1 ... X_n
• Weights for each input, W_1... W_n
• A bias input X_0 (constant) and associated weighted sum of inputs, y = W_0X_0 + W_1X_1 + ... + W_nX_n
• A threshold function, i.e 1 if y > 0, -1 if y <= 0

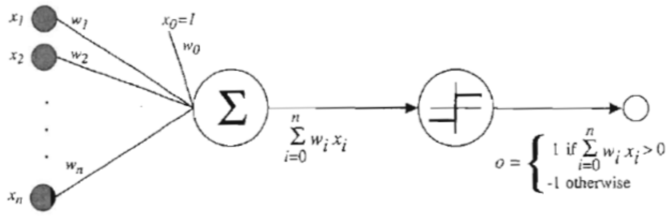

Fig.3 A Perceptron

IV. THE BACKPROPAGATION ALGORITHM

The backpropagation algorithm is used in layered feed-forward ANNs. This means that the artificial neurons are organized in layers, and send their signals forward, and then the errors are propagated backwards. The network receives inputs by neurons in the input layer, and the output of the network is given by the neurons on an output layer. There may be one or more intermediate hidden layers.

The backpropagation algorithm uses supervised learning, which means that we provide the algorithm with examples of the inputs and outputs we want the network to compute, and then the error (difference between actual and expected results) is calculated. The idea of the back propagation algorithm is to reduce this error, until the ANN learns the training data. The training begins with random weights, and the goal is to adjust them so that the error will be minimal.

The activation function of the artificial neurons in ANNs implementing the backpropagation algorithm is a weighted sum (the sum of the inputs xi multiplied by their respective weights W_{ji}):

$$A_j(\overline{x},\overline{w}) = \sum_{i=0}^{n} x_i w_{ji} \quad (1)$$

We can see that the activation depends only on the inputs and the weights. If the output function would be the identity (output=activation), then the neuron would be called linear. But these have severe limitations. The most common output function is the sigmoidal function:

$$O_j(\bar{x},\bar{w}) = \frac{1}{1+e^{(\bar{x},\bar{w})}} \quad (2)$$

The sigmoidal function is very close to one for large positive numbers, 0.5 at zero, and very close to zero for large negative numbers. This allows a smooth transition between the low and high output of the neuron (close to zero or close to one). We can see that the output depends only in the activation, which in turn depends on the values of the inputs and their respective weights.

Now, the goal of the training process is to obtain a desired output when certain inputs are given. Since the error is the difference between the actual and the desired output, the error depends on the weights, and we need to adjust the weights in order to minimize the error. We can define the error function for the output of each neuron:

$$E_j(\overline{x},\overline{w},d) = (O_j(\bar{x},\bar{w}) - d_j)^2 \quad (3)$$

We take the square of the difference between the output and the desired target because it will be always positive, and because it will be greater if the difference is big, and lesser if the difference is small. The error of the network will simply be the sum of the errors of all the neurons in the output layer:

$$E(\bar{x},\bar{w},\bar{d}) = \sum_j (O_j(\bar{x},\bar{w}) - d_j)^2 \quad (4)$$

The backpropagation algorithm now calculates how the error depends on the output, inputs, and weights. After we find this, we can adjust the weights using the method of gradient descendent:

$$\Delta w_{ji} = -\eta \frac{\partial E}{\partial w_{ji}} \quad (5)$$

This formula can be interpreted in the following way: the adjustment of each weight (Δw_{ij}) will be the negative of a constant eta (η) multiplied by the dependance of the previous weight on the error of the network, which is the derivative of E in respect to w_i.The size of the adjustment will depend on (η), and on the contribution of the weight to the error of the function.This is, if the weight contributes a lot to the error, the adjustment will be greater than if it contributes in a smaller amount. (5) is used until we find appropriate weights (the error is minimal). First, we need to calculate how much the error depends on the output, which is the derivative of E in respect to O_j (from (3)).

$$\frac{\partial E}{\partial O_j} = 2(O_j - d_j) \quad (6)$$

And then, how much the output depends on the activation, which in turn depends on the weights (from (1) and (2)):

$$\frac{\partial O_j}{\partial w_{ji}} = \frac{\partial O_j}{\partial \Delta j}\frac{\partial A_j}{\partial w_{ji}} = O_j\,(1 - O_j)x_i \quad (7)$$

And we can see that (from (6) and (7)):

$$\frac{\partial E}{\partial w_{ji}} = \frac{\partial E}{\partial O_j}\frac{\partial O_j}{\partial w_{ji}} = 2(O_j - d_j)\,O_j\,(1 - O_j)x_i \quad (8)$$

And so, the adjustment to each weight will be (from (5) and (8)):

$$\Delta w_{ji} = -2\eta(O_J - d_j)O_j(1 - O_j)x_i \quad (9)$$

We can use (9) as it is for training an ANN with two layers. Now, for training the network with one more layer we need to make some considerations. If we want to adjust the weights(lets call them V_{ik}) of a previous layer, we need first to calculate how the error depends not on the weight, but in the input from the previous layer. This is easy, we would change x_i with w_{ji} in (7), (8), and (9). But we also need to see how the error of the network depends on the adjustment of V_{ik}. So:

$$\Delta V_{ik} = -\eta \frac{\partial E}{\partial V_{ik}} = -\eta \frac{\partial E}{\partial x_i}\frac{\partial x_i}{\partial V_{ik}} \quad (10)$$

where:

$$\frac{\partial E}{\partial w_{ji}} = 2(O_j - d_j)O_j\,(1 - O_J)W_{JI} \quad (11)$$

And, assuming that there are inputs u_k into the neuron with V_{ik} (from (7)):

$$\frac{\partial x_i}{\partial V_{ik}} = x_i\,(1 - x_i)\,V_{ik} \quad (12)$$

If we want to add yet another layer, we can do the same, calculating how the error depends on the inputs and weights of the first layer. We should just be careful with the indexes, since each layer can have a different number of neurons, and we should not confuse them.

For practical reasons, ANNs implementing the backpropagation algorithm do not have too many layers, since the time for training the networks grows exponentially. Also, there are refinements to the backpropagation algorithm which allow a faster learning.

When found that the output is not equal to or greater than the threshold,the back propagation occurs and the weights given are changed until we get the desired output. Thus artificial neural network plays a very important role in building the neurons and controlling the information transmission among the neurons in the Blue Brain.

V. 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 "hardware" component of wetware concerns the bioelectric and biochemical properties of the CNS, specifically the brain. If the sequence of impulses traveling across the various neurons are thought of 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.

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.

A wetware computer is an organic computer (also known as an artificial organic brain or a neurocomputer) built from living neurons. Professor Bill Ditto, at the Georgia Institute of Technology, is the primary researcher driving the creation of these artificially constructed, but still organic brains.One prototype is constructed from leech neurons, and is capable of performing simple arithmetic operations. The concepts are still being researched and prototyped, but in the near future, it is expected that artificially constructed organic brains, even though they are still considerably simpler in design than animal brains, should be capable of simple pattern recognition tasks such as handwriting recognition.

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The sample of brain cells, which are procured from lab mice, are cultured on the circuit board itself and changes neural pathways and electrical currents as it adapts to its new body. Scientists are literally watching a brain grow and develop in real time, which may provide new knowledge about the way our minds operate and even how we heal. In addition to revolutionizing the way we look at computers and unmanned devices, this technology may also provide insights into cures for mental diseases that researchers have been dealing with for centuries.

Wetware technology is simply an interface between the natural neurons and the artificial neurons.In the Blue Brain, the wetware used is a software called "Neuron".It has also been suggested that, within ten years, people may be able to purchase their own living technology.

VI. FUZZY LOGIC

The way that people think is inherently fuzzy. The way that we perceive the world is continually changing and cannot always be defined in true or false statements. Take for example the set of all the apples and all the apple cores in the world. Now take one of those apples; it belongs to the set of all apples. Now take a bite out of that apple; it is still an apple right? If so, it still belongs to the set of apples. After several more bites have been taken and you are left with an apple core and it belongs to the set of apple cores. At what point did the apple cross over from being an apple to being an apple core? What if you could get one more bite out of that apple core, does that move it into a different set?

The definition of the apple and apple core sets are too strictly defined when looking at the process of eating an apple. The area between the two sets is not clearly defined since the object cannot belong to the set of apples and apple cores because, by definition, an apple core is NOT an apple. The sets defining apples and apple cores need to be redefined as fuzzy sets.

A fuzzy set allows for its members to have degrees of membership. If the value of 1 is assigned to objects entirely within the set and a 0 is assigned to objects outside of the set, then any object partially in the set will have a value between 0 and 1. The number assigned to the object is called its degree of membership in the set. So an apple with one bite out of it may have a degree of membership of 0.9 in the set of apples. This does not mean that it has to have a degree of membership of 0.1 in the set of apple cores though. However as the apple is eaten it looses its membership in the fuzzy set of apples and gains membership in the fuzzy set of apple cores.

There is more to fuzzy logic than some interesting math, it has some impressive applications in engineering. The main application of fuzzy logic in engineering is in the area of control systems. The definition of a control system, given by Richard Dorf in Modern Control Systems is: "An interconnection of components forming a system configuration that will provide a desired response." This means that a control system needs to know the desired response (input) and it needs to process this input and attempt to achieve it.

The process is the system that is being controlled and cannot typically be changed. The controller then, must take the input and also take measurements from the process and use this information to generate the appropriate input to the process. A basic example of a controller would be a summing point that will provide the difference between input and output to the process, whereas a more advanced controller would be a PID controller. A fuzzy logic based controller will use fuzzy membership functions and inference rules to determine the appropriate process input. Designing a fuzzy controller is a more intuitive approach to controller design since it uses a comprehensable linguistic rule base.

A fuzzy controller can be broken down into three main processes. The first of these is the fuzzification, this uses defined membership functions to process the inputs and to fuzzify them. These fuzzified inputs are then used in the second part, the rule-based inference system. This system uses previously defined linguistic rules to generate a fuzzy response. The fuzzy response is then defuzzified in the final process: defuzzification. This process will provide a real number as an output.

In Blue Brain, the fuzzy logic is what helps the human brain to take the decision.It is that logic which helps him to perform an action at the required time.The decision is made through the past experiences.

VII. THE BLUE BRAIN

Blue Brain is the world's first virtual brain to be developed.It can think like brain,take decisions based on past experience and respond like natural brain.It is an attempt to create a synthetic brain by reverse engineering the mammalian brain down to the molecular level.The main aim of this research is to upload human brain into machine. So that man can think and take decision without any effort. After the death of the body, the virtual brain will act as the man. So, even after the death of a person we will not lose the knowledge, intelligence, personalities, feelings and memories of that man that can be used for the development of the human society.The project was founded in May 2005 by Henry Markram at the EPFL in Lausanne, Switzerland. Goals of the project are to gain a complete understanding of the brain and to enable better and faster development of brain disease treatments.

The research involves studying slices of living brain tissue using microscopes and patch clamp electrodes. Data is collected about all the many di_erent neuron types. This data is used to build biologically realistic models of neurons and networks of neurons in the cerebral cortex. The simulations are carried out on a Blue Gene supercomputer built by IBM. Hence the name "Blue Brain". The simulation software is based around Michael Hines's NEURON, together with other custom-built components.

Typical scientists, impending research funders and scientific journalists are still doubtful on success of mind uploading. Significant mainstream research in related areas is being conducted in animal brains, comparing, contrasting and simulation, developing of faster super computers, virtual reality, brain-computer interfaces, connectors and information extraction from dynamically working brains.

A progressively vast community of thoughtful researchers has arisen, taking this seemingly science fictional knowledge seriously and running to it through experimental and theoretical research programs. These supporters mention many of the tools and ideas needed to achieve mind uploading activity; however, they also admit that it is very hypothetical, but still in the dominion of engineering potential.

Consciousness is a part of natural world. We believe that consciousness depends on mathematics and logic, laws of physics and chemistry and biology; its not magical. The concept of mind uploading is based on this mechanical view of the mind. It denies the ritualistic view of human life and consciousness. Eminent computer geniuses and neuro scientists have foretold that specially programmed machines will be capable of thought and even reach some level of consciousness. Such machine intelligence ability might offer a computational substrate necessary for uploading.

As of August 2012 the largest simulations are of mesocircuits containing around 100 cortical columns(image above right). Such simulations involve approximately 1 million neurons and 1 billion synapses.This is about the same scale as that of a honey bee brain. It is hoped that a rat brain neocortical simulation (21 million neurons) will be achieved by the end of 2015.A full human brain simulation (86 billion neurons) should be possible by 2023 provided sufficient funding is received.

A) WHY DO WE NEED AN ARTIFICIAL BRAIN?

Today we are developed because of our intelligence. Intelligence is the inborn quality that cannot be created .Some people have this quality, so that they can think up to such an extent where other cannot reach. Human society is always in need of such intelligence and such an intelligent brain to have with. But the intelligence is lost along with the body after the death. The virtual brain is a solution to it. The brain and intelligence will be alive even after the death. We often face difficulties in remembering things such as people names, their birthdays, and the spellings of words, proper grammar, important dates, history facts, and etcetera. In the busy life everyone wants to be relaxed. Can't we use any machine to assist for all these? Virtual brain may be a better solution for it.

B) HOW IS IT POSSIBLE?

It is helpful to describe the basic manners in which a person may be uploaded into a computer. Raymond Kurzweil recently provided an interesting paper on this topic. In it, he describes both invasive and noninvasive techniques. The most promising is the use of very small robots, or nanobots. These robots will be small enough to travel throughout our circulatory systems. Traveling into the spine and brain, they will be able to monitor the activity and structure of our central nervous system. They will be able to provide an interface with computers that is as close as our mind can be while we still reside in our biological form. Nanobots could also carefully scan the structure of our brain, providing a complete readout of the connections between each neuron. They would also record the current state of the brain. This information, when entered into a computer, could then continue to function like us. All that is required is a computer with large enough storage space and processing power.Many people believe firmly those we posses a soul, while some very technical people believe that quantum forces contribute to our awareness. But we have to now think technically. Note, however, that we need not know how the brain actually functions, to transfer it to a computer.

C) HOW TO BUILD A BLUE BRAIN?

It involves the following steps:

- Data Collection

It involves collecting brain portions, taking them under a microscope, and gauging the shape and electrical behavior of neurons individually. This method of studying and cataloguing neurons is very familiar and worldwide. The neurons are captured by their shape, electrical and physiological activity, site within the cerebral cortex, and their population density. These observations are translated into precise algorithms which describe the process, function, and positioning methods of neurons. Then, the algorithms are used to generate biologically-real looking virtual neurons ready for simulation.

- Data Simulation

The simulation step involves synthesising virtual cells using the algorithms that were found to describe real neurons. The algorthims and parameters are adjusted for the age, species, and disease stage of the animal being simulated. Every single protein is simulated, and there are about a billion of these in one cell. First a network skeleton is built from all the different kinds of synthesised neurons. Then the cells are connected together according to the rules that have been found experimentally. Finally the neurons are functionalised and the simulation brought to life. The patterns of emergent behavior are viewed with visualisation software.

VIII. BLUE BRAIN SOFTWARE DEVELOPMENT KIT

The Blue Brain SDK is a C++ library wrapped in Java and Python. The primary software used by this for neural simulations is NEURON.This software models neuronal cells by modeling fluxes of ions inside and outside the cell through different ion channels. These movement generate a difference of electrical potential between the interior and the exterior of the neuronal membrane, and modulations of this potential allows different neurons to communicate between each other. Michael Hines of Yale University and John Moore at Duke University developed this in the starting of the 1990s.It is freely available open source software. The website makes everything available including the code and the binary data freely. Michael Hines in cooperation with BBP team in 2005 ported the package into the massive and parallel Blue Gene.

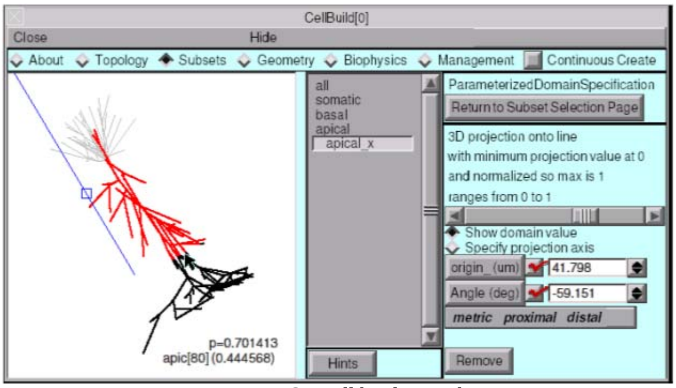

Fig.4 NEURON cell binder window

IX. VISUALIZATION

RT Neuron is the main application that Blue Brain Project uses for visualization of neural simulations. The BBP team developed this software internally. It is coded using C++ and OpenGL. RT Neuron is an ad-hoc software written specifically for neural simulations, i.e. it cannot generalized to other kinds of simulation. RT Neuron takes the output from Hodgkin-Huxley simulations as input in NEURON and delivers them in 3D. This allows the programmers and researchers to view as activation potentials propagate through or between neurons. The animations can be paused, stopped, started and zoomed, hence allowing the researchers to interact with the model. The visualizations are multi-scale (they can render individual neurons or a whole cortical column).Clusters of commodity PCs have been used for visualisation tasks with the RTNeuron software.

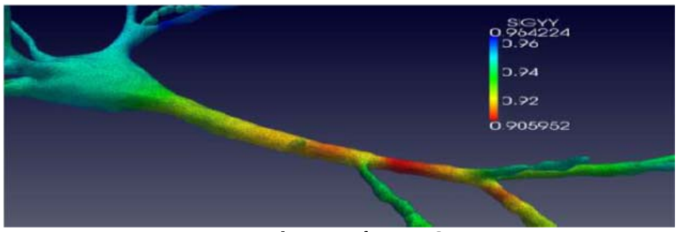

Fig.5 Visualization of NEURON

X. HARDWARES / COMPUTERS USED

A) Blue Gene/P

The primary machine used by the Blue Brain Project is a Blue Gene supercomputer built by IBM. This is where the name "Blue Brain" originates from. IBM agreed in June 2005 to supply EPFL with a Blue Gene/L as a "technology demonstrator". The IBM press release did not disclose the terms of the deal. In June 2010 this machine was upgraded to a Blue Gene/P. The machine is installed on the EPFL campus in Lausanne (Google map) and is managed by CADMOS (Center for Advanced Modelling Science).

Blue Gene/P technical specifications:

- 4096 quad-core nodes (16,384 cores in total)
- Each core is a PowerPC 450, 850 MHz
- Total: 56 teraflops, 16 terabytes of memory
- 4 racks, one row, wired as a 16x16x16 3D torus
- 1 PB of disk space, GPFS parallel file system

- Operating system: Linux SuSE SLES 10
- Public front end: bluegene.ep.ch and processing log

Fig.6 Blue Gene/P Supercomputer

B) JuQUEEN

JuQUEEN is an IBM Blue Gene/Q supercomputer that was installed at the Jlich Research Center in Germany in May 2012. It currently performs at 1.6 petaops and was ranked the world's 8th fastest supercomputer in June 2012. It's likely that this machine will be used for BBP simulations starting in 2013, provided funding is granted via the Human Brain Project. The JuQUEEN machine is also to be used by the JuBrain (Jlich Brain Model) research initiative. This aims to develop a three-dimensional, realistic model of the human brain.

Fig.7 JuQUEEN Supercomputer

C) DEEP- Dynamical Exascale Entry Platform

DEEP is an exascale supercomputer to be built at the Jlich Research Center in Germany. The project started in December 2011 and is funded by the European Union's 7th framework programme. The three-year protoype phase of the project has received 8.5 million. A prototype supercomputer that will perform at 100 petaflops is hoped to be built by the end of 2014. The Blue Brain Project simulations will be ported to the DEEP prototype to help test the system's performance. If successful, a future exascale version of this machine could provide the 1 exaflops of performance required for a complete human brain simulation by the 2020s.

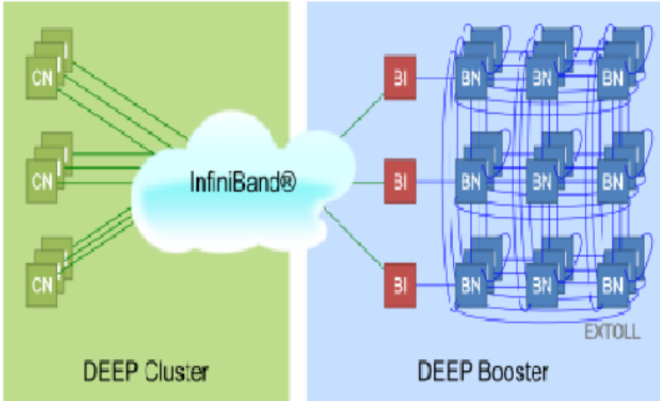

Fig.8 DEEP Supercomputer

XI. Applications

- Gathering and Testing 100 Years of Data.
- Cracking the Neural Code
- Understanding Neocortical Information Processing
- A Novel Tool for Drug Discovery for Brain Disorders
- A Global Facility
- A Foundation for Whole Brain Simulations
- A Foundation for Molecular Modeling of Brain Function

XII. Advantages And Disadvantages

A) ADVANTAGES

- Blue brain is an approach to store and utilize human intelligence and information present in the mind even after human demise.
- It is an important move towards self-decision.
- It can be used as an interface between human and animal minds.
- It a good remedy towards human disability like a deaf can get the information via direct nerve stimulation.

B) DISADVANTAGES

- It increases the risk of human dependency on Blue Brain every time.
- Once a Blue Brain related to a particular persons neural schema is hacked, the brain could be used against the very person.
- Since it an approach to make machines intelligent and thoughtful it increases the risk of machines conducting war against human.

XIII. Future Works

Blue Brain technology can be used in fully paralized people to communicate with the world.We have all heard about the very famous scientist Stephen William Hawking who has a motor neuron disease and is entirely paralysed. It is through a speech generating device that he communicates with the world. He would be able to contribute more to the world of science if he were physically sound. Through the blue brain technology we would be able to make use of the intelligence of such great men for the future developments.

Blue brain technology can be used in animal in order to find their mental state , and take precautions if any unfavourable or dangerous situation occurs.

GPS enabled chip can be installed in human beings like animal to trace the location if any missing occurs. The number of kidnaps and missing cases can be reduced to a great extend thus helping the investigators to make their easier and quicker.

Blue Brain technology can be used to know the communication between the animals and to study more about them.We have always wondered how these animals communicate with each other and how they take decisions. Using the blue brain technology we will be able to understand how this happens which will eventually help us to connect with the nature in a better way.

Poligraphy testing can be done with the help of this technology.The criminals and terrorists can be made to undergo this test inorder to know more about their mindset and activities which will help us to take necessary precautions to save our country from the black hands.

XIV. Conclusion

We believe that the time is right to begin assimilating the wealth of data that has been accumulated over the past century and start building biologically accurate models of the brain from first principles to aid our understanding of brain function and dysfunction.In conclusion, we will be able to transfer ourselves into computers at some point. Most arguments against this outcome are seemingly easy to circumvent. They are either simple minded, or simply require further time for technology to increase. The only serious threats raised are also overcome as we note the combination of biological and digital technologies.We believe that the connection with Blue Brain and Soul Catcher may exceed human intellectual capacity by around 2017, and that it is likely that we will be able to download the human brain at sometime around 2050.

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