BLUE BRAIN

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Abstract: ***The Blue Brain Project is an attempt to reverse engineer the human brain and recreate it at the cellular level inside a computer simulation. 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 different 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[3] built by IBM. Hence the name "Blue Brain". The simulation software is based around Michael Hines's NEURON[1], together with other custom-built components. As of August 2012 the largest simulations are of meso circuits 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 2014. A full human brain simulation (86 billion neurons) should be possible by 2023 provided sufficient funding is received.***

Keywords:Neurons, Brainmodeling, Supercomputers, Computational-modeling, Data models.

Introduction:

Human brain is considered as the biggest gift God has given to this world. Man is known to be the most intelligent animal because of his abilities that his brain gives him. The human brain converts the information transmitted by the impulses enabling a person to respond. The death of a person brings in the loss of his knowledge as his body gets destroyed. The same knowledge could have been used for further development of the society. What could have been the face of the earth today if we could still communicate with great scientists who contributed everything they could for a better society? Enter Blue Brain.

Today scientists are carrying out research to create an artificial brain that can think, respond, take decisions and store information. The main aim is to upload a human brain into the computer, so that it can think, and make decisions without the presence of a human body. After death, this virtual brain can act as the man. So, even after the death of a person, we will not lose the knowledge, intelligence, emotions, and memories of a person and this can be used for various situations like to continue the pending work, to decide on something based on his/her area of expertise etc.

The human brain is a complex system consisting of recursive connectors. It is more complex than any circuitry in the world. The human brain is a multi-level system with 100 billion neurons (nerve cells) and 100 trillion synapses. A neuron is a cell designed to transmit information to other nerve cells, muscle, or gland cells whereas synapses help neurons to communicate with each other. So, the question may arise, is it really possible to create a human brain? The answer is Yes. Today it is possible because of advancement in technology. The world of technology has expanded in areas like humanoid robots, computing, virtual reality, wearable devices, Artificial Intelligence, Digital jewelry, Blue Eyes Technology, BrainGate Technology and so much more at a rapid rate. A full human brain simulation (100 billion neurons) is planned to be completed by 2023 if everything goes well. If so, this would be the first virtual brain of the world.

Need of it:

A virtual brain is an artificial brain. It can think like the natural brain, take decisions based on the past experience, and respond as the natural brain can. It is possible to do so by using supercomputers, with a huge amount of storage capacity, 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 uploaded into the computer. So the brain and the knowledge, intelligence of anyone can be preserved and used forever, even after the death of the person which involves computer modeling[4].

- 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 to such an extent where others cannot reach. Human society would always need such intelligence and such an intelligent brain. But the intelligence is lost along with the person after death. Virtual brain is a solution to it. The brain and its intelligence can be alive even after death.
- We often face difficulties in remembering things such as people's names, their birthdays, and the spellings of words, proper grammar, important dates, history facts, and etcetera. A virtual brain modeling[2] can take away the extra stress we all face to remember things.It is a perfect technical solution to a very common human problem.

Working:

The human ability to feel, interpret and even see is controlled, in computer-like calculations, by the magical nervous system. Yes, the nervous system is quite like a magic because we can't see it, but it is working through electric impulses through your body.

The human brain is a multi-level complex system with 100 billion neurons and 100 trillion synapses. Not even engineers have come close to making circuit boards and computers as delicate and precise as the nervous system. To understand this system, one has to know following three simple functions.

1. *Sensory input***:** When our eyes see something or when our hands touch a warm surface, the sensory cells, also known as Neurons, send a message straight to our brain. This is called sensory input because we are putting things into our brain by way of senses.
2. *Integration***:** Integration is best known as the interpretation of things like taste, touch, and sense which is possible because

of our sensory cells, known as neurons. Billions of neurons work together to understand the change around us.

3. *Motor Output:* Once our brain understands the change, either by touching, tasting or via any other medium, then our brain sends a message through neurons to effector cells, muscles or gland cells, which actually work to perform our requests and act upon our environment. The word motor output is easily remembered if one should think that our putting something out into the environment through the use of a motor, like a muscle which does the work for our body.

EPFL:

IBM, in partnership with scientists at Switzerland's École Polytechnique Fédérale de Lausanne (EPFL) – a research institute, specialized in natural sciences and engineering, will begin simulating the brain's biological systems and output the data as a working 3-dimensional model that will recreate the high-speed electrochemical interactions that take place within the brain's interior. EPFL makes use of the supercomputer Blue Gene/P built by IBM. The machine is installed on the EPFL campus in Lausanne and is managed by CADMOS (Center for Advanced Modeling Science). These include cognitive functions such as language, learning, perception, and memory in addition to brain malfunction such as psychiatric disorders like depression and autism. From there, the modeling will expand to other regions of the brain and, if successful, shed light on the relationships between genetic, molecular and cognitive functions of the brain.

What is a Virtual Brain:

A virtual brain is an artificial brain. It can think like the natural brain, take decisions based on the past experience, and respond as the natural brain can. It is possible to do so by using supercomputers, with a huge amount of storage capacity, 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 uploaded into the computer. So the brain and the knowledge, intelligence of anyone can be preserved and used forever, even after the death of the person.

· 1. The Virtual Brain includes an array of new and useful measures for the brain's organization thanks to **extensive use of graph theory**: segregation, integration, efficiency and influence of subnetworks, nodes and their edges.

· 2. For the first time, The Virtual Brain provides the same qualities and quantifications of **common neuro-imaging methods EEG, MEG, fMRI** like for a real brain, making it ideal for **experimental validation and customization**.

The difference:

NATURAL BRAIN	SIMULATED BRAIN
The input is through natural neurons	The input is through silicon chip OR artificial neurons
The INTERPRETATION is done by different	The INTERPRETATION is done by states of brain.different set of bits in set of register.
The output is through natural neurons.	The output is through silicon chip.
The processing is through arithmetic and	The processing is through arithmetic logical calculations. and logical calculations and AI.
The memory is through permanent states	The memory is through Secondary of neurons. memory.

Requirement of Hardware and Software:

- A Super Computer
- Memory with a large storing capacity
- Processor with a high processing power
- A very wide network
- A program to convert electric impulses from the brain to input signal, which is to be received by the computer and vice versa.
- A very powerful Nanobots to act as the interface between the natural brain and computer.

Advantages:

1. Even after the death of a person his intelligence can be used.
2. This could boost study of animal behavior. That means by interpretation of the electric impulses from the brain of the animals, their thought process can be understood easily.
3. It would allow the deaf to hear via direct nerve stimulation, and also be helpful for many psychological diseases.
4. We could make use of the information of the brain that was uploaded into the computer and use it to provide a solution to mental disorder.

Disadvantages:

There could be new types of threats, this technology would bring.

1. Increases the dependency on computer systems.
2. Computer viruses will pose an increasingly critical threat. Data could be manipulated and used in wrong way. Read more about cyber crime.
3. This may lead to human cloning and we cannot imagine how big this threat would be against nature.

X. Conclusion:

The blue brain project, if implemented successfully, would indeed change many things around us and it will boost the area of research and technology. Certain research and development take decades or even centuries to complete, so the knowledge and efforts of a scientist can be preserved and used further in his absence. At the same time, it is not an easy task to replicate the convoluted brain system into a computer. It may take several years to decades to accomplish this.

Reference:

[1]: A **neuron** (also called neuron or nerve cell) is a cell that carries electrical impulses. Neurons are the basic units of the nervous system and its most important part is the brain.
Every neuron is made of a cell body (also called a soma), dendrites and an axon. Dendrites and axons are nerve fibres. There are about 86 billion neurons in the human brain, which comprises roughly 10% of all brain cells. The neurons are supported by glial cells and astrocytes.

[2]: Brain Modeling reviews models used to study neural interactions. The book also discusses 54 computer programs that simulate the dynamics of neurons and neuronal networks to illustrate between unit and systemic levels of nervous system functions.
Computer simulation models predict the various dynamic activity occurring in the complicated structure and physiology of neuronal systems. Computer models can be used in "top-down" brain/mind research where the systemic, global, and emergent properties of nervous systems are generated.

[3]: A **supercompute**r is a computer with a high level of performance compared to a general-purpose computer. Performance of a supercomputer is measured in floating-point operations per second (FLOPS) instead of million instructions per second (MIPS). As of 2017, there are supercomputers which can perform up to nearly a hundred quadrillion FLOPS.
As of November 2017, all of the world's fastest 500 supercomputers run Linux-based operating systems. Additional research is being conducted in China, the United States, the European Union, Taiwan and Japan to build even faster, more powerful and more technologically superior exascale supercomputers.

[4]: Computer Modeling is the use of computers to simulate and study the behavior of complex systems using mathematics, physics and computer science. A computational model contains numerous variables that characterize the system being studied. Simulation is done by adjusting each of these variables alone or in combination and observing how the changes affect the outcomes. The results of model simulations help researchers make predictions about what will happen in the real system that is being studied in response to changing conditions

[5]: Data Models consist of brain related data, several Analyzer algorithms are currently available to “process” the results. It is known that most data analysis approaches are still “work in progress”, thus TVB should allow for the greatest possible flexibility on the side of the S-User when it comes to any kind of data algorithm. This being the case, TVB should allow for the user to adapt his/her own analysis tools.