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Blue Brain- the future

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Abstract

Abstract: *God's most significant and unique creation is the human brain. The fact that man is intellectual describes properly and places humans in a category distinct from and superior to other creatures. The world's first virtually produced brain is known as "Blue Brain." That is, a machine that can act in the place of a human brain. Scientists are working on a machine that can think, respond, make judgments, and remember everything. This concept's main goal is to map the human brain onto a cutting-edge machine. Man will be able to keep and utilize any individual's thinking and analytical ability indefinitely if this is accomplished. After the body has perished, the digitally generated brain will function as the thinking process. So, even after a person's death, we will have access to that person's knowledge, intelligence, sentiments, and memories, which can be used for the advancement of human society and a variety of other good deeds. Technology is advancing at a breakneck pace. IBM (also referred to as big Blues) is currently working on developing a virtual brain known as "Blue Brain." They include cognitive processes such as language, learning, perception, and memory, as well as brain abnormalities such as depression and autism. The Blue Brain project simulates the human brain by gathering data from its surroundings using specialized software, analyzing it using neuronal electrophysiology and morphology, and recreating it on computers. As a result, The Blue Brain project is a useful tool for studying the human brain, as well as for the advancement of the brain and society.*

Keywords: *Blue Brain, Neuronal electrophysiology, Morphology.*

1. Introduction

The Blue Brain is a method of "Reverse Engineering" the human brain and reconstructing it at the cellular level within a computer simulation. Henry Markram of the EPFL in Lausanne, Switzerland, began the study in May 2005. The project's goals are to gain a thorough understanding of the brain and gain access to it, as well as to find better and faster therapies for brain diseases.

Using patch clamp electrodes and highly magnified microscopes, researchers examine slices of living brain tissue. Data is acquired on all of the different types of neurons. This data is used to develop biologically accurate models of cerebral cortex neurons and neural networks. The simulations are carried out using an IBM Blue Gene supercomputer, hence the nickname "Blue Brain.". The simulation makes use of Michael Hines' NEURON simulation programme, as well as other custom-built components. Micro circuits of over 100 cortical columns, including around 1 million neurons and 1 billion synapses, were used in the most complicated simulations as of August 2012. [3]

The storage of a human's intelligence, knowledge, and personality in a digital form is one of the key goals of Blue Brain technology. As a result, one of Blue Brain's key goals is to upload the human brain into the virtual brain.

However, the question of how the human brain may be uploaded into the virtual brain may arise. Nanobots are the answer to that question. [5]

Nanobots can then give a complete scan of the structure of the brain and its activity with comprehensive readout of the connections in the brain. Once this information is uploaded in the computer it begins to function as the natural brain and becomes the entire data in the natural brain is uploaded into the virtual brain's computer as a substitute for our individuality. [3]

2. What is Blue Brain?

BLUE BRAIN is a virtual brain that will act as if it were a real brain. The human brain is the world's most complex structure. i.e., an artificial brain that, while not identical to a human brain, may perform similar functions. It can think like a brain, make decisions based on prior experience, and act in the same way that a natural brain would.[4].

IBM is developing artificial intelligence that is similar to the Blue brain. It would be the world's first virtual brain. In 30 years, we will be able to scan ourselves into computers. It can think like a brain, make crucial and reflex judgments based on prior experience, and react in the same way that a natural brain does. A supercomputer with a massive quantity of storage capacity will be employed in conjunction with high-speed processing capability to serve as an interface between the human and artificial brains. This interface will allow the data held in the natural brain to be uploaded into the source computer. As a result, a person's brain and its contents of knowledge and intelligence will be stored and used indefinitely, even after the person has died. Blue brain is a notion that permits all of the contents of a human brain to be copied or transferred into a simulated virtual brain that dwells inside a supercomputer. According to the latest information, the supercomputer utilized in this is Blue Gene. It's like putting a person's thoughts into a computer.[1]

3. Comparison Between Natural Brain and Virtual Brain

Table 1 shows the comparison between Natural Brain and Virtual Brain.

Table 1: Comparison between Natural Brain and Virtual Brain

Natural Brain	Virtual Brain
INPUT: Neurons in the nervous system are in charge of expressing our body language. The cells of our body accept the sensory inputs. Concept of these things Generate electrical impulses generated by neurons in a small room. These electrical impulses lead to brain neurons.	**INPUT:** An artificial nervous system can be created in the same way that a human rain is created. Artificial neurons were created and replaced with a silicon chip by the scientist. The ability of these neurons to accept data from sense cells was also confirmed. These artificial neurons can thus get electrical impulses from sensory cells. [3]
Interpretation: The electrical signals that the brain receives from neurons are processed by the brain. In the brain, various states of numerous neurons are used to interpret information. [3]	**Interpretation:** The electrical impulses received by the artificial neuron can be interpreted by registers. The various values in these registers represent various mental states.
Processing: When we make a decision, think of something, or execute computations, our neural circuit performs the logical and mathematical calculations.[8] To give the output, previous experience and present input signals are used, and the status updates of specific neurons are adjusted.	**Processing:** Similarly, stored states and received information, as well as arithmetic and logical calculations, can be used in computer decision making.

Memory: Certain neurons in our brain are permanently associated with certain situations. Our brain can represent this condition if relevant, and we can recall events from the past. We compel neurons to exhibit particular states of the brain forever or for any intriguing or significant subject in order to remember things. This occurs unintentionally.	**Memory:** Certain neurons in our brain are permanently associated with certain situations. Our brain can represent this condition if appropriate, and we can recall events from the past. We stimulate neurons to exhibit particular states of the brain forever or for any intriguing or significant subject in order to remember things. This occurs spontaneously.[3] It's tough to maintain data in a secondary memory for an extended period of time. Similarly, the relevant register states can be saved indefinitely and retrieved and used as needed. [7]
Output: Brain sends electrical impulses that show the responses that our body's sensory cells are still receiving in response to neurons in the brain at this time, dependent on the neu-ron's circumstances.[3]	**Output:** Depending on the register's features, the output signal can be transferred to artificial neurons in the body that are received by the sensory cell. [8]
Power Consumption Having around 50 billion neurons and 500 trillion connections, it is almost impossible to consume only 25 watts of power [1], which is how much power the human brain consumes. [9]	**Power Consumption** Although nano-technology and ultra low power design promises a viable solution for it and in the future, this may not pose to be that big of an issue. [7]

4. Hardware/Software Requirements

4.1.Blue Gene/P

The Blue Brain project's primary machine is the IBM Blue Gene supercomputer. As a result, the term "blue brain" was coined. IBM committed to deploy the EPFL Blue Gene / L as a "technology demonstrator" in June 2005. The deal's specifics aren't disclosed in the IBM press statement. This machine was upgraded to Blue Gene / P in June 2010.

CADMOS (Center for advanced science modelling) oversaw the installation of the machine on the EPFL Lausanne campus. Several research groups, notably the Blue Brain project, use the computer. BBP accounted for roughly 20% of computing time in mid-2012. Brain modelling takes place once a week and lasts for an entire day (usually on Thursdays). The rest of the week is spent to simulation preparation and analysis. The public can view supercomputer utilization statistics and work history on the internet. Look for activities that are labelled "C-BPP." [3]

Blue Gene/P technical specifications

1. Nodes with 4,096 quad-core processors
2. A PowerPC 450, 850 MHz processor is used in each core.
3. There are 56 teraflops and 16 terabytes of memory in total.
4. wired like a bull 3D 16x16x16 racks, one row

GPFS parallel file system, 5. 1 PB of disc capacity

5. Linux SuSe SLES 1 as the operating system [3]

Blue brain Storage rack - In November 2009, this machine was ranked as the world's 99th fastest supercomputer. [3]

Silicon Graphics- The results were displayed on a Silicon Graphics Inc. (SGI) machine with 32 CPUs and 300 GB of shared memory. [3]

PC Cluster of Products - Basic PC groups were utilized to visualize the RT Neuron software. [3]

4.2. BBPSDK

The Blue Brain Project - Software Development Kit (BBP SDK) is a set of software classes (APIs) that researchers can use to test models and simulations. The SDK is a C++ library that comes with Java and Python

pre-installed. To study models and simulations, researchers might use software classes (APIs).[3]

4.3. JuQUEEN

In June 2012, it was the world's seventh fastest supercomputer, with a performance of 1.6 petaflops. If funds from the Human Project Brain arrive, this calculator will most likely be utilized for BBP simulations starting in 2013.The supercomputer will be expanded with more racks in October 2012. It's uncertain how many racks there will be and how quickly they will be completed. The research endeavor will also use the Ju QUEEN machine. The goal is to create a three-dimensional and realistic brain model. [3]

4.4. Dynamical Exascale Entry Platform (DEEP)

Jülich Research Center built DEEP (deep-project.eu), a German exascale supercomputer. The 7th Framework Program of the European Union funded the initiative, which began in December 2011. The project's prototype phase, which will last three years, has been given € 8.5 million.
By the end of 2014, a prototype supercomputer with 100 petaflops will be created. The Blue Brain project's simulations to test system performance revolve around the DEEP prototype. If the trial goes well, a future exascale version of this computer might fully reproduce the human brain by 2020.The DEEP prototype is made with Intel MIC processors (multiple integrated cores) that each have more than 50 CPU cores and are made on a 22 nm process.[3]

4.5. Magerit

A supercomputer jointly constructed by the Technical University of Madrid and IBM. In 2005, it was hosted in the Madrid Supercomputing and Visualization Center (CeSViMa). [4]

4.6. HPI SGI 8600

In July 2018, it was decided to deploy a Hewlett-Packard supercomputer for the new phase of the Blue Brain technology.[4]

4.7. Neuron

Michael Hines of Yale University and John Moore of Duke University devised the programme in the 1990s. [4]

4.8. RTNeuron:

RT Neuron is a piece of software developed by the Blue Brain Project team in-house. It's a programme that's largely used for visualizing brain simulations.[4]

5. Application of Blue Brain

- 100 Years of Data Collection and Testing [2]: One of the most useful uses is the creation of a working model that gathers and tests knowledge about the microstructure and functioning of the neocortical column over the last 100 years.
- Cracking the Neural Code [2]: The activity of building objects using electrical patterns by the brain is known as Neural Coding and the code thus generated is known as Neural Code. Thus, it is critical to make an accurate duplicate of the Neural Code that can reproduce the emergent dynamics of the actual microcircuit so that we may learn more about how the neocortex processes work and how it stores and retrieves data.
- Neocortical Information and Its Interpretation: It is possible to create accurate simulations only through predictions that may be generated in the neocortex. And to create an accurate replica of the Neural Code, iteration between simulations and experiments are a must.
- A Way for efficient Discovery of Drugs for Brain Disorders [1]: An important application of the virtual brain technology is that it lets one perform any tests, experiments and analysis on it rather than the real brain. Thus, testing of

new drugs and discovery of brain disorders and their treatment becomes extremely convenient and risk.

- Preservation and utilization of a person's intelligence alive and even after their death: As discussed before, Blue brain will allow a new host for the knowledge, information and a person's intelligence both while alive and after death. This would help in preserving essential characteristics of a person's personality, thought and intellect, and would serve in keeping the person 'alive 'even after death
- A Foundation for the Whole Brain Simulation [1]: Another application of Blue Brain is that it creates a base for the future simulation and analysis of the brain and further research on the topic.
- Molecular Modelling of Brain Function as a Foundation [1]: As is the case with Brain Simulations, it has also built a foundation for the molecular modelling of brain functions by attempting to create an accurate replica of the neocortical column with whose advancement the complexity of the molecular model of the brain functions will increase gradually as well.

6. Merits and Demerits of Blue Brain

Merits:

- Preservation and restoration of a person's memory, whether living or dead; particularly successful in the event of "short-term" memory loss.
- Without exerting any effort, memories can be recalled.
- Even when the person is not present, decisions are made. [2].
- Even after death, a person's intelligence can be preserved and used. [5].
- Wildlife's activities and behavior can be better understood.[5].
- Research on the human brain is extremely essential, and it is helping to solve the riddle that is the human brain.
- The development of novel pharmaceuticals and the investigation of the cause, effect, and therapy of brain problems without the use of harmful brain experiments.

Demerits:

- Computer reliance and dependency at an all-time high [5].
- Others' misuse of technical knowledge [2].
- Computers consume a tremendous amount of power, approximately 1MW.
- Even if memories are better kept, they are still vulnerable to other threats, such as computer viruses.
- If a person's intellect is hacked into the system, it could be utilized against them. [5].
- It's a very expensive and complicated system.
- The development of an intelligent computer system poses a threat to humanity's future.

7. Conclusion

If executed properly, the blue brain project will alter many aspects of our lives while also boosting research and technology. The majority of the objections to this conclusion appear to be easily overcome. They are simple to comprehend, or the technology simply requires more time to develop. The majority of potential negative influences appear to be simple to avoid. They are either simplistic in their thinking or simply need more time for technology to advance. Things can be memorized easily, and decisions may be taken without the need for a person's presence. Even after a man's death, intelligence can be employed. Despite the fact that the future is uncertain, research has already enabled this model to gain valuable knowledge. It is possible to comprehend the behavior of several animals. That is, their thoughts can be easily understood by reading the electrical impulses of the animal's brain. Blue Brain can be used as a foundation for brain simulations as well as a tool for drug development in brain diseases. At the same time, Blue Gene supercomputers can simulate up to 100 cortical columns, one million neurons, and one billion synapses. When we uncover the combination of biological and digital technology, we can also conquer the only major threats. Even after death, the intelligence of the human brain will

be stored for the benefit of society. Without the presence of a person, we can make decisions. But it's also true that we'll be reliant on computers. It will have both beneficial and negative consequences for humanity. This is roughly equivalent to a bee's brain power. Humans, on the other hand, have approximately two million pillars in their cortex. Regardless of the project's difficulties, it should be completed by 2023.

References

1. Gourav Kumar Jha, Sushant Kumar Verma, Govind Prasad Arya, Blue Brain - A Survey, International Journal of Scientific & Engineering Research, Vol.7, Issue 12, December-2016, pp.48-54.

2. Verm, S, Kohli, B. Blue Brain. International Journal of Scientific and Research Publications, Vol. 5, Issue 10, October 2015, pp.1-4.

3. Himani Singh Rana, Himanshu Sirohia, Virtual Brain-The Future Generation, Journal of Current Science, Vol. 20, No 01, January 2019, 14th-Conference(IC-GAEMPSH).

4. Madhulika Vinny, Pawan Singh, Review on the Artificial Brain Technology: Blue Brain, Journal of Informatics Electrical and Electronics Engineering, Vol. 01, Issue 01, 2019, pp. 1-11.

5. Sharma, S., Payal, N., A. Kaushik, N. Goel, N. (2014) Blue Brain Technology: A Sub Way to Artificial Intelligence. Proceedings of the 4th International Conference on Communication Systems and Network Technologies, Bhopal, India, 7-9 April 2014, pp.1106-1109.

6. Palak Chaubey, Manish Dubey, Blue Brain, International Research Journal of Engineering and Technology, Vol. 06 Issue 06, June 2019, pp.3547-3551.

7. Meet Gidwani, Anand Bhagwani, Nikhil Rohra, Blue Brain - The Magic of Man, Proceedings of International Conference on Computational Intelligence and Communication Networks, December 12-14, 2015, Jabalpur, India.

8. Henry Markram, The Blue Brain Project.

9. Blue Brain Technology: A Sub Way to Artificial Intelligence, - Proceedings of the Fourth International Conference on Communication Systems and Network Technologies, 7-9 April, 2014, Bhopal, India, pp.1106-1109.