



Review on Blue Brain for Novice

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Abstract:

Uploading the human brain into the supercomputer is called Blue Brain. So the machine can function as human and it can take decisions. The Cognitive learning method is used for simulation here. Based on the working principle of human brain, virtual brain is modeled. Blue brain will not come under the category of Artificial intelligence (AI), it comes under the subset of AI that is deep machine learning. The more processing power is needed to here to simulate the whole brain. With advantages there also demerits associated with this technology. The major objective of the Blue Brain Project is to crack open secrets of how the brain rewires itself every moment of its existence. The resultant knowledge would lead to a new breed of super computers.

Keywords: Cognitive Learning, Machine Learning, Nano robots, Pattern Recognition, Liquid Computing.

I. INTRODUCTION

Human brain is the most valuable creation of God. Because of death, our body and brain get destroyed. It is possible to transplant our body organs and make them alive even after our death. It is also possible to make our brain (i.e. intelligence) to alive even after death. Human brain gets copied into computer, so the intelligence of anyone can be loaded into the computer. The computer can take decisions and think. Currently Henry Markam and his team at Ecole Polytechnique Federale de Lausanne (EPFL) in Lausanne, Switzerland are doing the blue brain project. The main aims of this project to give remedy for so many brain disorders by know about working principle of human brain. There are so many AI algorithms exist such as OpenNN, Neural Designer, (artificial) Human, HNet Application development System, nupic, Encog, Neuroph, Vicorious Recursive Cortical Network, Visual Hierarchical Modular Neural Network, Artificial Intelligence Logic Electronic Emulation Neural Network. But Blue Brain is completely different from these AI algorithms.

1.1 Why the name Blue Brain:

The supercomputer used for uploading the human brain is named as Blue Gene. So the world's first virtual brain is called Blue Brain.

II. WORKING PRINCIPLE OF HUMAN BRAIN

2.1 Neurons in Human Brain:

Our brain consists of nerve cells called neurons. Neurons are responsible for sending signals to the brain. The mammalian brain contains 100 million to 100 billion neurons, depending on the species. A neuron makes connection with 10 to 100,000 other neurons at junction called synapses. They transmit electrical impulses along their axons. By using electrochemical reaction these electric impulses called signals get transmitted from neuron to neuron. So as said earlier these signals control the brain.

2.2 Functioning of human brain:

2.2.1 Sensory Input:

The getting of information from our surroundings is called sensory input. For example, if we smell a rose or our eyes see something, suppose our hands touch a hot water, then these information's are send to brain by using sensory cells. Neurons are responsible for message passing; the electric impulses produced by sensory cells are received by neurons. Then neurons are responsible for sending these electrical impulses to brain. Neurons are classified into Sensory neurons and inter neurons and Motor neurons.

2.2.2 Memory:

There are certain neurons in our brain which represent certain states permanently. When required this state is represented by our brain and we can remember the past things.

2.2.3 Interpretation:

The electrical impulses received by the brain from neurons are interpreted in the brain based on some processing.

2.2.4 Processing:

The past experience stored in memory and the current inputs which are sending by sensory cells are used to take decision or think about something we can make any computation. Then the states of certain neurons are changed to give output.

2.2.5 Output:

Then the responses are interpreted by our brain.(suppose we touch something hot, our brain intimates us to leave the hands touching the hot surface). These responses are sending by our brain again by means of electric impulses through the neurons.

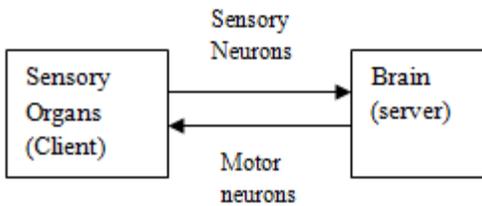


Figure.1. Workflow of Human Brain

Our Brain is the server that stores all kinds of information in different states of neurons. Then the sensory organs are clients that requesting the brain for response (what to do, how to do...)

III. NANOROBOTS

The Uploading of human brain is possible by the use of small robots are called nano robots. Nano robots act as an interface between the natural brain and the computer and the program for the conversion of electrical signals into digital signals to be received by a computer and vice versa. They are so small that they can travel through circulatory systems and finally reaches our brain and spine. Its basic functionality is to monitor the activities of neurons and scans the structure of brain, providing complete read out connections between each neuron. They should also record the current state of the brain. Then details carried by the neurons are transmitted into computer.

IV. WORKING PRINCIPLE OF BLUE BRAIN

4.1 Data acquisition:

First we need to acquire data for that we need to study the different types of neurons and catalogue them. We need to identify which neuron is responsible for which function. For that purpose we take brain slices and placing them under microscope and measure the shape and electrical activity of neurons.

4.2 Virtual neurons:

By using the Electrophysiology behavior, location of neurons and their population density are observed. Based on that neurons are get classified. Then the form of neurons, function and positioning are studied and based on that mathematical algorithms are generated. Now Virtual neurons are ready. These virtual neurons are integrated in a silicon chip.

4.3 Functions of Blue Brain:

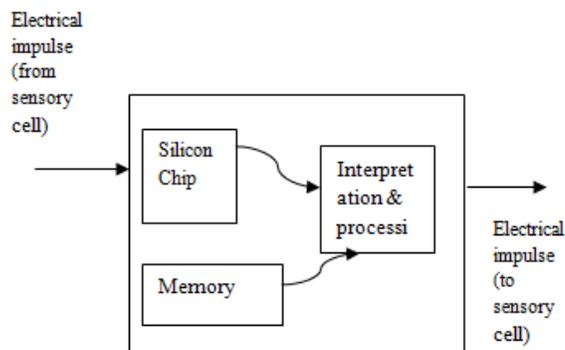


Figure.2. Workflow of Virtual Neuron

4.3.1 Sensory Input:

It has been tested that neurons within the silicon chip receive electrical impulse from sensory cells. So the electrical impulse

from sensory cells can be received through these artificial neurons.

4.3.2 Memory:

Neurons store some information permanently in our brain. Likewise the past data are stored in the register permanently by using secondary memory (Past data). When required these information can be received and used.

4.3.3 Interpretation:

The electrical impulses received by the artificial neuron are interpreted by means of registers. Different values in these registers will represent different states of the brain.

4.3.4 Processing:

Decision making can be done by the computer by using some store states in memory and received input and we can use some arithmetic and logical calculations.

4.3.5 Output:

The decision made in processing segment will be given as output. This output signal travel through artificial neurons which will be received by the sensory cell.

V. MILESTONES ACHIEVED IN BLUE BRAIN PROJECT

- In November 2007, the project reported the end of the first phase, delivering a data driven process for creating, validating and researching the neocortical column.
- The first artificial cellular neocortical column of 10,000 cells was built by 2008. (rat neocortical column contains only 10,000 neurons, but humans contain 60,000 neurons.)
- In 2011 a cellular microcircuit of 100 neocortical columns with a million cells was built.
- In 2012, using Blue Gene Supercomputers, up to 100 cortical columns, 1 million neurons and 1 billion synapses can be simulated at once. This is roughly equivalent to the brain power of a honey bee.
- Cellular rat brain in 2014 with 100 mesocircuits totalling a hundred million cells is built.
- In 2015, scientists at Ecole Polytechnique Federale de Lausanne (EPFL) developed a quantitative model of the previously unknown relationship between the glial cell atrocities and neurons. This model describes the energy management of the brain through the function of the neuro-glial vascular unit (NGV). The additional layer of neuron-glial cells is being added to Blue Brain Project models to improve functionality of the system.
- In 2017, this project uncovered a universe of multidimensional (nearly 7 to 11 dimensions) geometrical structures and spaces within the networks of the human brain. These structures arise when a group of neurons form a clique. Each neuron connects with every other neuron in the group in a very specific way that generates a precise geometric object. The more neurons in the clique, then higher the dimensions of geometric object.
- Finally a cellular human brain is predicted possible by 2023 equivalent to 1000 rat brains with a total of a hundred billion cells

*A neocortical **column**, also called hyper column, macro column, functional **column** or sometimes cortical module, is a group of neurons with similar properties are arranged in columns (about 2mm high) in the cortex of the brain. It is involved in higher functions such as sensory perception, generation of motor commands, spatial reasoning, conscious thought, and in humans, language.

VI. TOOLS USED IN BLUE BRAIN PROJECT

BBP-SDK:

The Blue Brain Project – Software Development Kit, a set of Application Programming Interfaces allow the researchers to use and audit prototypes and simulations. The Blue Brain Project – SDK is a C++ library wrapped in Java and Python.

NEURON:

The primary software used for neural simulation is NEURON. It uses C, C++ and FORTRAN. It is freely available open source software.

RT Neuron:

Visualization of neural simulations is possible by the use of RT Neuron. The BBP team developed this software internally. It is coded using C++ and OpenGL. RT Neuron's input is output from the NEURON software. This allows knowing how electric impulses propagate through or in between neurons.

Silicon Graphics:

32 bit processor with 300 GB of memory is used in visualization of results. It helps in studying the working of neurons. It is also used in storing the state so that it could be used to remember things. It acts as artificial neuron in Blue Brain technology.

Blue Gene/L Super Computer: used till 2009

Blue Gene/P Super Computer: used till 2011

Blue Gene/Q Super Computer (JuQUEEN)

VII. METHODOLOGIES USED IN BLUE BRAIN

Blue Brain is not a single technology; it is an umbrella for various technologies like following:

7.1 Cognitive Learning:

Blue Brain is come under Cognitive Learning. Before Cognitive Learning we need to find the differences between artificial intelligence, machine learning and deep machine learning. Artificial intelligence is systems behave as much like humans. Data are fed into the system and gives the same output for same input. But in Machine Learning machines can think and act and learn from the given data. Deep Learning is same as Machine Learning, but here we are dealing with more data(Big Data). Whereas in Cognitive Learning, it focuses on symbolic and conceptual information rather than just pure data on server streams. Human experience and Human judgment are considered in Cognitive learning.

7.2 Liquid Computing:

In Blue Brain project, the results of one neuron is interconnected with another, so not able to use grid computing. Supercomputers are needed so more processing is needed for proper functioning

of blue brain. Human brain changes its state frequently ie based on universal processing (any time processing). A big problem a brain has is to solve how to keep thinking about something that it just saw while the world around it never stops sending it new information. Suppose if we sending some information continuously into the system, it shuts because it can't finish one thing before it has to start on another problem. The Best remedy for this is Liquid Computing. Liquid computing can in principle solve any problem instaneously and keep solving them in real time with infinite parallelization. But it's very difficult to build good liquid computer.

7.3 Pattern Recognition:

Pattern recognition is a concept in machine learning. It is the ability of an individual to consider a complex set of inputs, often containing hundreds of features, and make a decision based on the comparison of some subset of those features to a situation which the individual ha previously encountered or learned. Here in blue brain also pattern recognition algorithms are used to take a decision.

VIII. MERITS AND DEMERITS OF BLUE BRAIN TECHNOLOGY

8.1 Merits:

- Most Intelligent person's intelligence can be preserved even after their death. Imagine if the brain of Stephen William Hawkings, APJ Abdul Kalam are preserved using Blue Brain, then how lucky we are! Definitely there will be drastic change in our society.
- We can remember things without any effort. Decisions can also make without the presence of the person.
- The activity of different animals can also be identified. By interpreting electrical impulses from the animal's brain, their thinking can be understood easily.
- It is helpful for many psychological diseases like short term memory or volatile memory.

8.2 Demerits:

- Human beings will become dependent on the computer systems.
- Hackers may misuse the technical knowledge.
- Computer virus will pose an increasingly critical threat.
- Think if machine gives suggestions as like an Executive then unemployment is the result.

IX. CONCLUSION

By using Blue brain technology, we will able to transfer ourselves into the computer. It is not easy to upload our brain into super computer, because our brain is the more complex to learn. If it is succeeded there are so many serious threats related to security will arise. Because of Blue Brain project the IBM developed so many super computers and planned to build liquid computers, and it has impact on neuroscience, nueroinformatics, nuerorobotics and high performance computing.

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