

Study on Blue Brain

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Abstract— The Blue Brain 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 built by IBM. Hence the name "Blue Brain". The simulation software is based around Michael Hines's NEURON, together with other custom-built components. 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 2014. A full human brain simulation (86 billion neurons) should be possible by 2023 provided sufficient funding is received.

Key words: Blue Brain

I. INTRODUCTION

In future, our brains are going to be attacked by the blue brain!! Yeah that's right, but there is nothing to be worried, as it is going to be really useful for us. As sir Isaac Newton once said that we are like small kids on the sea shore, who are getting curious and excited by finding sea shells and fossils, but beyond the beach there is a huge ocean with diverse creatures and things yet to be discovered. Similarly he wants to say that in the field of technology, there are many things to be invented that might bring a drastic change in the field of science and technology. Human brain is the most valuable creation of god. Intelligence is lost after a person's death, but how can we restore this intelligence? Is there a solution for it? Yes there is and it is called the blue brain technology. Blue brain is the world's first virtual brain. It is been developed by IBM and within the span of 30 years we will be able to scan ourselves into the computer. The project was initiated and founded by Henry Markram in May 2005 at EPFL.



Fig. 1: Henry Markram

II. IN BRIEF

The goal of the Blue Brain Project is to build biologically detailed digital reconstructions and simulations of the rodent, and ultimately the human brain. The supercomputer-based reconstructions and simulations built by the project offer a radically new approach for understanding the multilevel structure and function of the brain. The project's novel research strategy exploits interdependencies in the experimental data to obtain dense maps of the brain, without measuring every detail of its multiple levels of organization (molecules, cells, micro-circuits, brain regions, the whole brain). This strategy allows the project to build digital reconstructions (computer models) of the brain at an unprecedented level of biological detail. Supercomputer-based simulation of their behavior turns understanding the brain into a tractable problem, providing a new tool to study the complex interactions within different levels of brain organization and to investigate the cross-level links leading from genes to cognition.

III. WHY IS THIS IMPORTANT?

Understanding the brain is vital, not just to understand the biological mechanisms which give us our thoughts and emotions and which make us human, but for practical reasons. Understanding how the brain processes information can make a fundamental contribution to the development of new computing technology – neurorobotics and neuromorphic computing. More important still, understanding the brain is essential to understanding, diagnosing and treating brain diseases that are imposing a rapidly increasing burden on the world's ageing populations.

Even a brain that is much smaller than the human brain, like the brain of a rat, is so complex that may never be possible to exhaustively measure all its anatomical features or to fully characterize the physiological interactions within

and between its different levels of organization. But this may not be necessary. The structure of the brain and the physiology of its components are subject to tight biological constraints, which are reflected in experimental measurements. The BBP exploits these interdependencies to build comprehensive digital reconstructions from the sparse experimental data that is available and to refine these reconstructions as the data improve. This ability makes the BBP approach inherently scalable.

Simulations suggest that our reconstructions can accurately reproduce many phenomena reported in previous laboratory experiments – without changing the parameters of the reconstruction. As digital reconstructions are refined, expanded, and validated for new kinds of experiment, they can become an ever more valuable resource for neuroscience research, allowing experiments and providing insights that would not be possible with alternative approaches.

IV. NEED OF VIRTUAL 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. What will happen if we upload ourselves into computer, we were simply aware of a computer, or maybe, what will happen if we lived in a computer as a program?

V. HOW TO UPLOAD DATA INTO VIRTUAL BRAIN?

The uploading is possible by the use of small bots called "Nanobots". They are so small that they can travel through brain and spiral. Its basic functionality is it will monitor activities of neuron and scans the structure of brain. It defines the data using sensory technology (Figure 2).

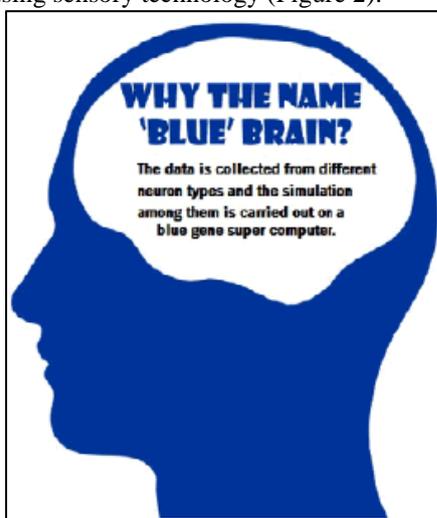


Fig. 2: Blue Brain

There is a method called data acquisition where by using neuroLucida software package which runs on windows workstation, we reconstruct the Neuronal 3D morphologies by taking the brain slices from the living being. For the Blue brain project a 12 patch clamp instrument was specially developed for it which studies the behaviour of neurons.

In simulation, there is software NERON which is written in C, C++ and FORTRAN where we study the cells using algorithms. These algorithms have to be defined according to age; breed of the living being that is simulated. The software collect data from nanobots is BBP-SDK i.e. Blue Brain Project Software Development Kit. The results are then visualised by RT neuron application written in C++ and OpenGL.



Fig. 3: Bird

Using these developments, an experiment was performed using a South American sparrow. A computer model of the bird's lungs was developed. Just as the bird sings forcibly through the folds of tissues, these impulses were transferred to the model which started singing like the bird.

VI. FUNCTIONING OF BRAIN

The nervous system is one of the complicatedly organized electron mechanisms and it is like a miracle because we cannot see it but it is working via electric pulses in our body. Even the engineers are not able to make the circuit boards and devices as accurate as the nervous system. The three simple functions of the brain are:

- Sensory input
- Integration
- Motor input

A. Sensory Input

When you keep the things into your brain through senses or from your surrounding environment called as sensory input. If you touch a warm surface/cold surface the information/data/message is passed to your brain through your sensory cells also called as neurons.

B. Integration

Integration is nothing but the interpretation or explanation of all the things that we feel, taste with our sensory cells the so-called neurons into the output that the body recognizes. This process is carried out in the brain where many neurons take part for understanding the current situation

C. Motor Output

If once our brain has the explanation of all the things that we learned through our sense then it sends a direct message

through the neurons to the effector cells, muscle cells or gland cells which work to respond to a request and act upon the environment. The example of this is our hearing, smelling etc.

VII. ADVANTAGES

- The blue brain is an easy way to store and use human intelligence and data or information present in the mind even after the death of the body.
- It will be a vital step towards self-decision making of a device containing the blue brain.
- It can do all important functions like an intelligent machine.
- It can avail as interference between human beings and animals. The blue brain program was implemented on rat and it was a success, provides a sign of success in future too.

VIII. DISADVANTAGES

- The human kind becomes dependent on machines.
- Another fear is about human cloning and regaining the memory back is an expensive procedure.
- Others may use technical knowledge against us.
- Another fear is found today with respect to human cloning.

IX. APPLICATIONS

- 1) Data of 100 years can be tested.
- 2) Neural Code can be cracked.
- 3) Information Processing of Neocortical can be understood.
- 4) Whole brain simulation can be studied.
- 5) A drug for the Brain Disorders.

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