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DIGITIZING HUMAN BRAIN: BLUE BRAIN PROJECT

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ABSTRACT

Human brain is most complex and unique creation of nature which is developing from ages by adaptation process and making humans more and more intelligent. Blue brain project is working in direction to digitize the human brain. Here my objective is to get deep knowledge of on-going blue brain project and work in field of digitizing the human brain based on study of blue gene supercomputer, quantum leap, blue column which are part of blue brain project. The aim of blue brain project is to develop a virtual brain that can act as humans and take can act response, make decisions, as like humans and upload the human brain into machine.

Keywords: FLOPS, neocortical, neurons, neural network, virtual brian.

I. INTRODUCTION

Blue brain project is an effort to reconstruct the human brain digitally at cellular level by reverse engineering process. They aimed to create a virtual brain by modeling the neocortical column found only in mammals. Blue gene is a supercomputer that can process data by peta FLOPS range is developed by IBM, which is involved in blue brain project to simulate the mammal's brain with high level of accuracy.

II. ABOUT BLUE BRAIN

IBM is developing world's first virtual brain. It will take decades to get at some level of creating virtual brain. Blue brain project is an effort to reconstruct the human brain digitally at cellular level by reverse engineering process.

Blue brain project was started in July of 2005, under prof. Henry Markam from Brain Mind institute at EPFL and IBM.They aimed to create a virtual brain by modeling the neocortical column. Neocortical column is found only in mammals. It saves the information about environment, food and other resources which are necessary for survival. Neocortical column underlines all sensory and information processing with higher mental functions, general movements and behavioral responses.

Reverse engineering a section of neocortical column [1] includes many levels of details about microscopic cells and neuron fibers in living brain and their dynamic entities. Blue brain project is running on supercomputer called Blue gene. Blue gene is a supercomputer developed by IBM, which is involved in blue brain project to simulate the mammal's brain with high level of accuracy (biological), and to study the steps involved in biological intelligence. The calculation speed goes beyondpeta FLOPS range. As a normal human brain requires

a high speed of processing beyond petaFLOPS, the blue brain project is increasing theprocessing power of their supercomputer blue gene, to reach the human level of data processing.

III. NEED OF VIRTUAL BRAIN

Today we are developed due to our intelligence. Intelligence is the inborn quality that can't be created. Some people have this quality, in order that they will think of to such an extent wherever alternative cannot reach. Human society is usually in want of such intelligence and such an intelligent brain to own with. However the intelligence is lost alongside the body after the death. The virtual brain may be an answer to that. The brain and intelligence are alive even once the death. We often face difficulties in memory things like individual's names, their birthdays, and therefore the spellings of words, proper grammar, vital dates, history facts, and etcetera. Within the busy life everybody desires to be relaxed. Can't we tend to use any machine to help for all these? Virtual brain could also be an improved answer for it. What's going to happen if we tend to upload ourselves into pc, we tend to were simply tuned in to a computer, or maybe, what's going to happen if we tend to live in a very computer as a program? This can lead us to immorality.

IV. BLUE GENE – THE SUPERCOMPUTER

Blue gene is a supercomputer developed by IBM; it is built by using system on a single chip technology. In blue gene supercomputer all the functions except the main memory is integrated on a single integrated circuit called as single application specific integrated circuit (ASIC) [3].

ASIC includes two power PC cores running at 700MHz. A 64 bit double floating point unit (FPU) which can operate in single instruction multiple data (SMID) is associated with each core. The peak performance of a chip or node is about 5.6 billion floating points per second or GFLOPS.

The blue brain project's blue gene supercomputer contains 4-rack system that includes 4,096 nodes which has 8,192 CPUs. This supercomputer generates overall peak performance of 22.4 TFLOPS, which can further increased to 64-rack machine to reach 360 TFLOPS peak performance.

Fig. 1 | The Blue Gene/L supercomputer architecture [3]

VI. THE QUANTUM LEAP

In neural networks, each neuron receives inputs from other thousands of neurons connected on different branches. For these microcircuit a massive computation power is required which is provided by IBM's supercomputer blue gene. By utilizing computational power of blue gene supercomputer the aim of blue brain project is to build accurate model of mammal's brain.

The first stage of blue brain project is to develop the cellular level of a young rat. The cellular level is different from genetic or molecular level models. In last decade the blue brain lab has prepared for reconstruction of columns. This reconstruction is developed by multi-neural patch-clamp approach [9].

The data recorded from hundreds of thousands of neocortical neurons and their connections (synaptic connection). By recording of this data quantitative approach is developed to allow a complete numerical detailing and breaking down from smallest building blocks of the neocortical column fig.

The blue brain lab's database has the raw data and they are working on major initiative to make these data about neocortical column, synaptic connections, multi-neuron patch-clamp and overall data to public accessible database.

The research and so-called as 'blue-print' of circuit is not fully complete, but has sufficient level of data to begin the reconstruction at cellular level.

VII. BLUE COLUMN

Blue brain project is working on blue column which is the sensory column, it is evolutionary and simple and highly accessible too. The sensory column can be matured, transformed or even evolved to study development, specialization and evolution.

The blue column is a template; it contains around 10,000 neocortical neurons. The blue column template has the dimensions of 0.5 mm * 1.5 mm. It contains different types of neurons in it different
layers from layer 1-6 [6].

These are multiple subtypes of pyramidal neurons, spiny stellate neurons and other anatomical electrical type of interneurons in different layers from 1-6.

Developing Blue Column requires a multiple data transformation or manipulations. In first step, 3 dimensional neuron data is collected form experiments and correct errors obtained during preparation and reconstruction and maintain database from which the neuron classes are obtained.

Further the electrical capturing is done by taking each neuron and inserting ion channel models.

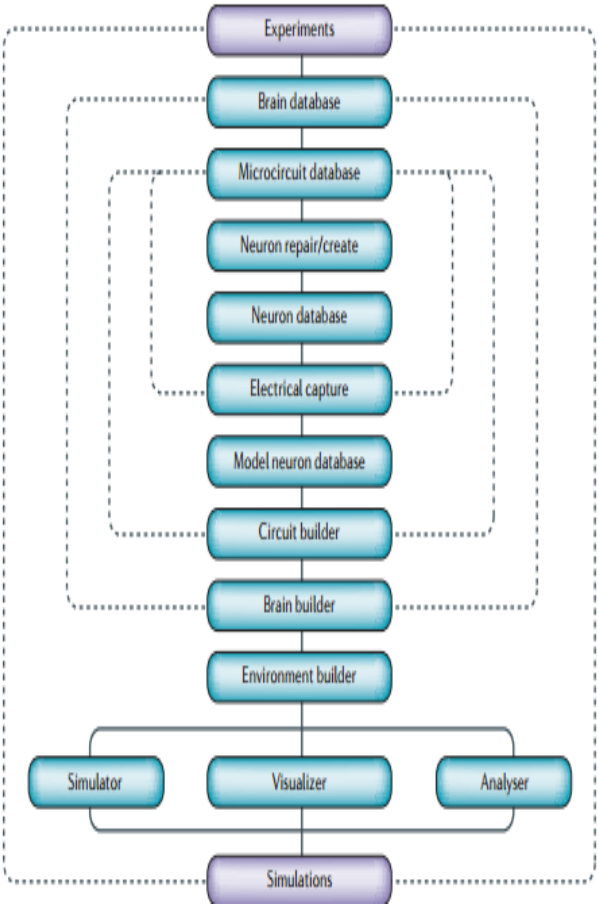

Fig. 2 | the data manipulation cascade [2]

Neurons are arranged into layers w.r.t. their classes and characteristics, by importing three dimension neuron into blue builder, it's a circuit builder. Blue brain project team has developed two software programs which used in simulating, large-scale data and neuron and deal with complexity of neurons. They are MPI's NEURON [7] and neocortical simulator (NCS) [8]. NEURON and NCS both of this software can simulates thousands of electrically complex neurons.

The main limitations of digitizing human brain are the high level temporal and spatial resolutions needed by biological process and other limitations of algorithms.

VIII. CONCLUSION

The research is about how we can digitize the human brain with Blue gene, creating Blue columns and applying in real life scenario. I got the deep knowledge about functioning of human brain which can lead to my further model of digitizing human brain.Indeed, it is essential to guide reductionist research into the deeper facets of brain structure and function.This will take decades of time to digitize the human brain.By applying data processing of Blue Gene supercomputers, up to hundreds of cortical columns, more than 1 million neurons, and billionsof synapses can be simulated at once. Blue Brain project gives us a new way of thinking and working about intelligence and consciousness, and extends our understanding of intelligence and generate new theories of consciousness.

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