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The Blue Brain – A Computational Structure for Intelligent Information Processing

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Abstract—Researches from the domains of neuroscience have been striving hard to understand the working of human brain, Understanding how neurons collectively represent the sensory input, perform computations and guiding behavior is one of the central goals of neuroscience. While the importance of studying populations of neurons has been recognized for decades, the experimental and theoretical tools to empirically investigating the computational properties of neural populations had been lacking till recently. It is now becoming increasingly clear that information processing in the brain is highly state-dependent. In other words, both neural activity and behavior are not entirely determined by the external stimulus alone, but can be highly modulated by internal states and endogenously generated dynamics. Cognitive processes such as attention or behavioral states can lead to widespread modulations of neural excitability. In addition the joined research in the field of computer science and neuronal behavior have endowed a path to build a computational framework for intelligent information processing. This paper provides aggregate working strategies of collaborative cognitive cycle of the leading brain prototyping projects to unveil the treasures inside the mind.

Keywords: Cognitive Cycle, Motivation, Action Composition, CCM

I.INTRODUCTION

BLUE BRAIN- The name of the world's first virtual brain. That means a machine that can function a human brain. Today scientists are in research to create an artificial brain that can think, response, take decision, and keep anything in memory. No one has ever understood the complexity of human brain. It is complex than any circuitry in the world. So, question may arise "Is it really possible to create a human brain?" The answer is "Yes". Because whatever man has created today always he has followed the nature. When man does not have a device called computer, it was a big question for all .But today it is possible due to the technology. Technology is growing faster than everything. IBM is now in research to create a virtual brain. It is called "Blue brain ".If possible, this would be the first virtual brain of the world.

II.NEURONAL EPISODES AND THEIR FUNCTION

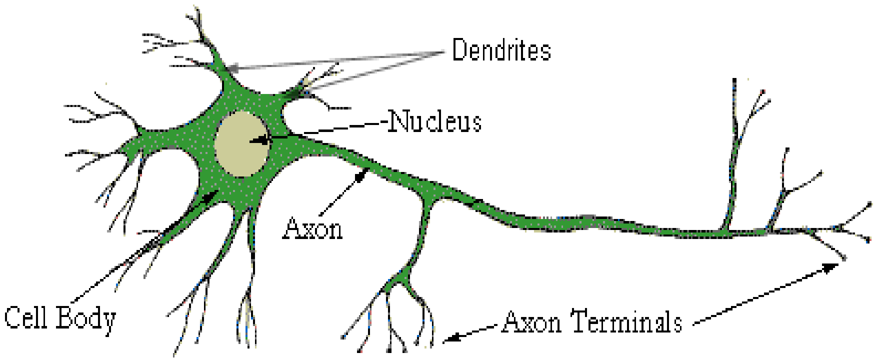

Figure 1 Neuronal Structure

1. CELL BODY

The cell body (soma) is the factory of the neuron. It produces all the proteins for the dendrites, axons and synaptic terminals and contains specialized organelles such as the mitochondria, Golgi apparatus, endoplasmic reticulum, secretory granules, ribosomes and polysomes to provide energy and make the parts, as well as a production line to assemble the parts into completed products.

2. DENDRITES

These structures branch out in treelike fashion and serve as the main apparatus for receiving signals from other nerve cells. They function an "antennae" of the neuron and are covered by thousands of synapses. The dendritic membrane under the synapse (the post-synaptic membrane) has many specialized protein molecules called receptors that detect the neurotransmitters in the synaptic cleft. A nerve cell can have many dendrites which branch many times, their surface is irregular and covered in dendritic spines which are where the synaptic input connections are made.

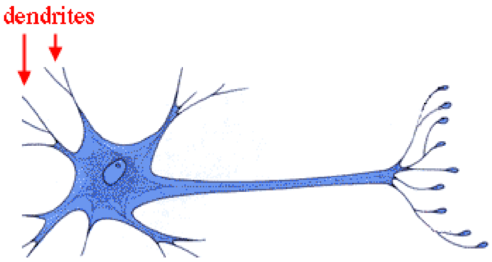

Figure 2 Dendrites

3. AXON

The axon is the main conducting unit of the neuron, capable of conveying electrical signals along distances that range from as short as 0.1 mm to as long as 2 m. Many axon split into several branches, thereby conveying information to different targets. Many neurons do not have axons. In these so-called amacrine neurons, all the neuronal processes are dendrites. Neurons with very short axons are also found. The axons of many neurons are wrapped in a myelin sheat, which is composed of the membranes of interstícial cells and is wrapped around the axons to form several concentric layers. The myelin sheath is broken at various points by the nodes of Ranvier, so that in cross section it looks like a string of sausages. The myelin protects the axon, and prevents interference between axons as they pass along in bundles, sometimes thousands at time. The cells that wrap around peripheral nerve fibers - that is, nerve fibers outside of the brain and spinal cord - are called Schwann cells (because they were first described by Theodor Schwann). The cells that wrap around axons within the central nervous system (brain and spinal cord) are called oligodendrocytes. The axon, with its surrounded sheath, is called a nerve fiber.

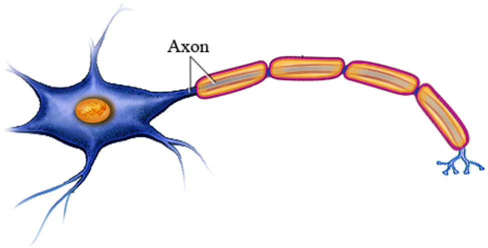

Figure 3 Axon

III.SYNAPSE

Synapses are the junctions formed with other nerve cells where the presynaptic terminal of one cell comes into 'contact' with the postsynaptic membrane of another. It is at these junctions that neurons are excited, inhibited, or modulated. There are two types of synapse, electrical and chemical.
Electrical synapses occur where the presynaptic terminal is in electrical continuity with the postsynaptic. Ions and small molecules passing through, thus connecting channels from one cell to the next, so that electrical changes in one cell are transmitted almost instantaneously to the next. Ions can generally flow both ways at these junctions i.e. they tend to be bi-directional, although there are electrical junctions where the ions can only flow one way, these are know as rectifying junctions. Rectifying junctions are used to synchronize the firing of nerve cells. Chemical synaptic junction is more complicated. The gap between the post- and presynaptic terminals is larger, and the mode of transmission is not electrical, but carried by neurotransmitters, neuroactive substances released at the presynaptic side of the junction. There are two types of chemical junctions. Type I is an excitatory synapse, generally found on dendrites, type II is an inhibitory synapse, generally found on cell bodies. Different substances are released at these two types of synapse. The direction of flow of information is usually one way at these junctions.

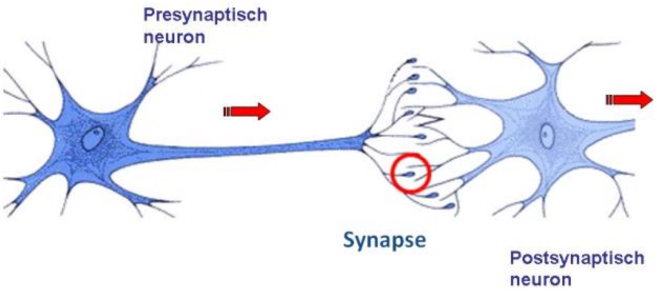

Figure 4 Structure of Synapse

Each terminal button is connected to other neurons across a small gap called a synapse. The physical and neurochemical characteristics of each synapse determines the strength and polarity of the new input signal. This is where the brain is the most flexible, and the most vulnerable. Changing the constitution of various neurotransmitter chemicals can increase or decrease the amount of stimulation that the firing axon imparts on the neighbouring dendrite. Altering the neurotransmitters can also change whether the stimulation is excitatory or inhibitory [4].

IV.CONNECTING BRAIN -PARALLEL MEMORY SYSTEMS

Research into complex brain networks is a fascinating, but also a collaborative effort. It is not only about how the brain is connected, it is also about how you connect brains [3]. Neurobiological results suggest that the memory system in brains is composed of several distinct anatomically and functionally dissociable subsystems. The current classical version of the multiple parallel memory systems (MPMSs) theory hypothesizes three central structures: the hippocampus, the dorsal striatum, and the amygdala. The respective neural circuits of these three structures encode and process specialized memory information and generate behavior to the outside world [2].The below architecture addresses the establishment of cognitive and collaborative social goals, The agent acts upon the environment with the help of its Internal context functions and knowledge base. In acquiring the desired results, At the end of specific task is performed with joint effort [8].

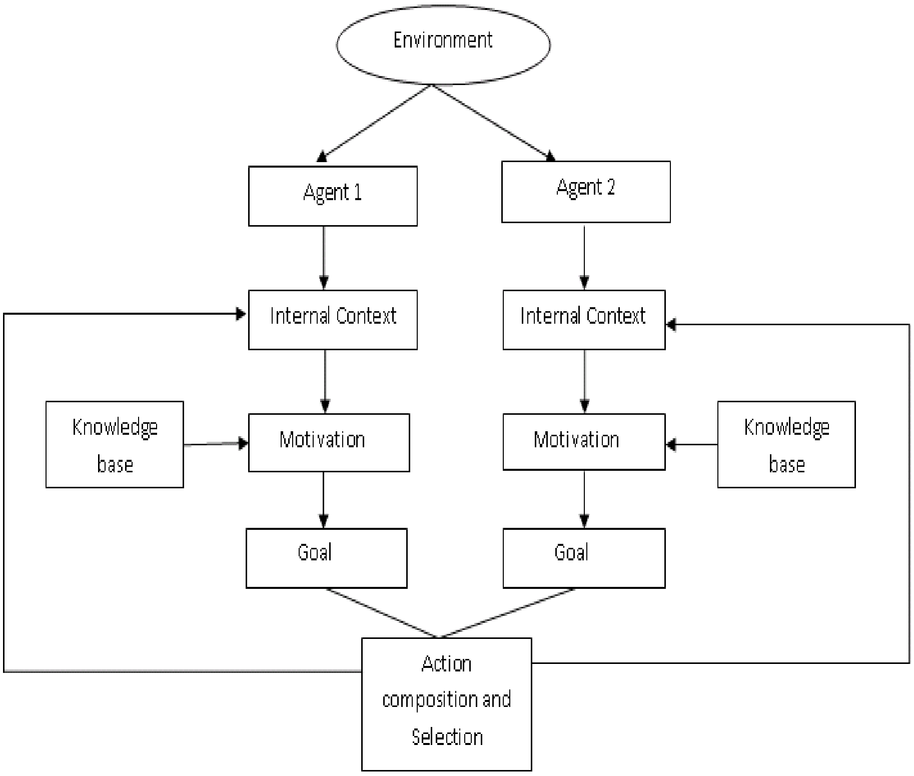

Figure 5 Architecture of the Collaboratively Motivated System

V. CCM MODEL

Cognitive cycle is a basic procedure of mental activities in cognitive level. Human cognition consists of cascading cycles of recurring brain events. A cognitive cycle for the mind model CCM (Collaborative Cognitive Model). Each cognitive cycle perceives the current situation, through motivation phase with reference to ongoing goals, and then composes internal or external action streams to reach the goals in response. We use dynamic description logic which is an extended description logic with action to formalize descriptions and algorithms of cognitive cycle. In problem solving, particular for production systems, solving cycles were proposed.

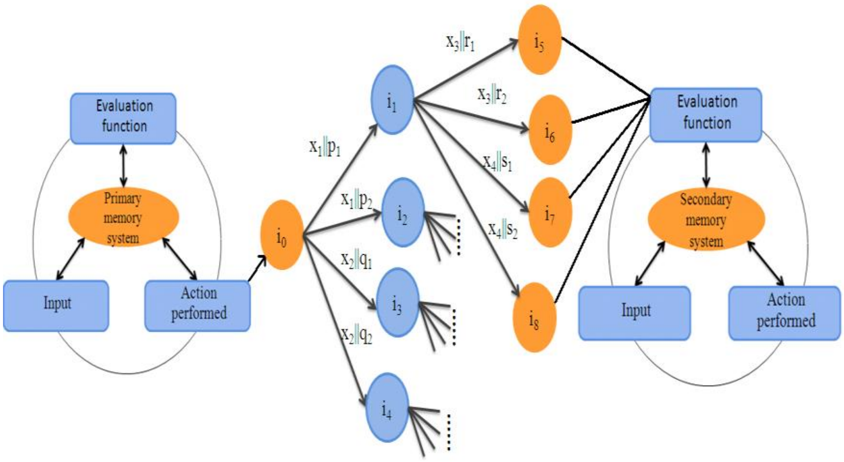

Figure 6 Collaborative cognitive Cycle (CCM)

The above CCM Model consist of primary memory system and Secondary memory System of two collaboratively functioning agent which receives input and performs action based on the evaluation function. In addition to that, if requested and environment allows helps each other. In job accomplishment this is shown in figure 6. In the case of collaborative behavior, agents also make commitments that constrain their behavior. joint commitments allow agents to depend on each other and to filter alternative courses of action efficiently. Our model describes how the need to make joint commitments drives the behavior of a collaborative agent.And provides them with the knowledge they need in order to function, and also provides a communication between knowledge-based components. This knowledge base is assumed to be able to represent and reason about the beliefs, desires, and truths of both the agents.The specific key to understand how initiative is handled are

- Primary memory system is handled as a suggestion to the Secondary memory System, that it makes certain commitments. Asynchronously, the secondary memory system's acceptance or rejection of the suggestion drives the system's collaborative behavior.
- System initiative is handled by the secondary memory system achieving the system collaborative goal.

To attain CCM the memory system relies on the state change of the system as represented in its KB and a set of reactive procedures. The Collaborative component would perform the following procedure:

1. If there is a jointly agreed value , then the goal has been achieved.
2. Otherwise, if the system believes it has already committed to a value, it will report that.
3. Otherwise, if the system desires some value individually, then it will propose that.
4. Otherwise, if it believes that the user desires some value, then it will check that.
5. Otherwise, so far as the system believes, neither party has a preference, so it will ask the user.

Let's assume that the first three queries fail, and that the system decides to ask the user about the failure. This will be realized by the sub-system . The Collaborative agent has now done all that it can do towards the goal, and so it suspends work on that goal pending new circumstances. Where goals can come from either the primary or the secondary system. The system's behavior with respect to its commitments is driven by a formal model of CCM based on a theory of joint motivation. This model not only drives the agent's own behavior, but also allows it to interpret the percepts and actions of the parallel system in a uniform manner. The model of collaboration and its role in the system is entirely demand and domain-independent. We believe that the associated architecture is a practical way to develop collaborative systems based on knowledge base. We are currently trying to do just that in several application areas like disaster recovery, heuristic classification, expert systems, computer vision, understating natural language and several artificial domains used to further explore the use of CCM in non linear problem solving.

V.CONCLUSION

Intelligence will connect machines and living beings via cerebrum−machine interfaces, enhancing strengths and compensating for weaknesses by combining the biological cognition capability with the Machine computational capability.

The challenge for us has been to apply these principles of collaborative neuronal processing between two memory systems basing inter-agent collaboration on joint commitments . key to the Shared formalism builds on Shared Plans and implements a collaborative cognitive model that performs actions. which corresponds to our view of the separate Collaboration component of the peer initiated system. We have concentrated on the problems of interpreting memory systems, and in particular how the same knowledge that drives collaboration can be used to interpret the user's input. We imagine that in less constrained real time situations there would be huddles similar to those we face in collaborating intelligent systems.

In brain−machine integration, an agent playing a single role and all can work together for a shared goal. As any dynamic problem is usually beyond the agent's discrete capabilities, as since it must explore its ability only by collaborating with its neighbors.

VI. FUTURE WORK

In future to reverse engineer the human brain and recreate it at the cellular level inside a computer simulation. 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 synthesis era in neuroscience started with the launch of human brain project and is inevitable phase triggered by a critical amount of fundamental data. The data set does not need to be complete before such a phase can begin. Detailed models will probably become the final form of databases that are used to organize all knowledge of the brain and allow hypothesis testing, rapid diagnoses of brain malfunction as well as development of treatments for neurological disorders. In short, we can hope to learn a great deal about brain function and dysfunction from accurate models of the brain. A model of the entire human brain at the cellular level will probably take the next decade. As with deep blue, Blue Brain will allow us to challenge the foundations of our understanding of intelligence and generate new theories of collaborative consciousness.

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