

System Dynamics Conception of Cognitive Consciousness: A Convergent Systemic Interface to Artificial Neural Network and Genetic Algorithm

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Abstract

The domain or system of Cognitive consciousness can be hypothesized to be one such system where number of endogenous and exogenous variables have dynamic interplay impacting the physiology, minds and meditations of individuals and spiritual Consciousness practitioners. Hence, understanding the non-linearity of this form of evolutionary Cognitive-physical dynamic system would be of paramount significance.

System Dynamics, Artificial Neural Networking and Genetic Algorithm have the potential of approximating the behavior of extremely complex systems such as of Spiritual-physical system. The paper conceptualizes systemic interfaces between SD, ANN and GA in order to explain the dynamics of Cognitive-physical system through their connectionist approaches that may also be quite instrumental in developing an Experiential Learning System for attaining consciousness of high order.

1. Introduction

A system is a group of interacting, interrelated, and interdependent components that form a complex, unified whole. In the area of dynamic modeling researches, System Dynamics, Artificial Neural Network and Genetic Algorithm have emerged as computational models offering remarkable opportunity for developing feedforward-feedback enabled experiential learning system.

1.1 System dynamics

Founded over the pioneer work done by Prof.J.W.Forrester (Massachusetts Institute of Technology MIT, USA), System Dynamics can take credit of being the first branch of mathematical research capable of modeling and optimizing highly diversified techno-socio-economic systems.

System Dynamics approach lies in modeling complex real world systems as flow rates and accumulations linked by information feedback loops involving delays and non-linear relationships. Methodologically, system dynamics has always placed a strong emphasis on the notion of counter-intuitive behavior of complex dynamic systems. The dynamism of such systems comes from the intricate interplay between many interrelated factors and the non-linearity of their relationships that is practically very difficult to predict from a description of their static structures.

1.2 Framework of system dynamics modeling

Stock-flow diagrams graphically represent the system and facilitate a core part of the system dynamics approach. (See **Figure 1** for a small part of a stock-flow diagram). A stock (shown in the diagram as a rectangle) is an accumulation whose value can only be changed by flows in and out (the double-lined arrows). The amount of flow in and out is regulated by rates (the cone on the flows), which is in turn controlled by a feedback loop. Hence, the feedback path for a closed system includes, in sequence, a stock, information about the stock, and a decision rule- Feedback that controls the change in the flow. In this case, an information link "transmits" information back to the **flow** variable about the state (or "level") of the **stock** variable. This information is used to make decisions on how to alter the flow setting.

1.3 System Dynamics approach towards Cognitive Consciousness

Dynamic Systems approach of cognitive consciousness holds that cognition can be explained by means of a continuous dynamic system in which all the elements are interrelated. In this regard, The domain or system of cognitive consciousness can be hypothesized to be one such system

where number of endogenous and exogenous variables have dynamic interplay impacting the physiology, minds and meditations of individuals and Consciousness practitioners. Hence, understanding the non-linearity of this form of evolutionary Cognitive-Physical dynamic system should be paramount.

One can safely infer that dealing, controlling and optimizing only 'segmented' variables or components of a Cognitive-physical system would lead to sub-optimization of the whole system and that too through an erroneous way of consciousness awakening. Hence the requirement is of a holistic conception which would enable construction of a dynamic model for the variability and uncertainty of a non-linear-diversified Cognitive-physical system representing complex interdependencies between various influencing **interest flow or stock variables** and help realistically analyze the performance trade-offs associated with different consciousness awakening decision making assumptions.

Such endeavor will also take into account the time evolutionary dynamics endogenously created by such cognitive-physical system structures stretched over a dynamic time-track. Leaving the constituent **interest** actors to strive to optimize their individual performances will definitely lead to a weak or sub-optimal consciousness awakening solution.

Hence, system dynamics-framework based consciousness related decision making is preferably essential in order to provide the basic building blocks necessary to construct such system models that help in developing our fundamental understanding about the impact-dynamics of such multileveled-multi variable complex systems over human minds and their corresponding efforts to awaken their consciousness. For a practitioner or decision maker of consciousness, the goal would be to leverage this added understanding to design and implement effective consciousness awakening solutions.

Now, a much simplified 'single stock-multiple flow' order cognitive-physical system dynamic model can be conceptualized (**See Figure2**), where 'Consciousness Awakening' is treated as a stock variable as it indicates the

level or accumulation of consciousness in terms of high consciousness quotient whose value can only be changed by flows in and out (the double-lined arrows). These flows are controlled by a **(+)** **positive** feedback loop emanating from the stock of 'gained consciousness' eventually reinforcing the entire consciousness dynamic system by positively triggering the values of inflow variables conceptualized here as 'Consciousness Genome' and 'Consciousness Neurons' under the dynamic evolutionary channel-variables of ANN & Genetic Algorithm.

The model also envisages dynamic reinforcement loops (+) mutually created between and amongst the sub-system variable components of ANN, GA, Consciousness Neurons and Consciousness Genome themselves. Thus, the model provides a holistic view of the system, which is done graphically by showing causal relationships between different elements of the system and with the system as a whole. It has to be reiterated that, another key element of the system dynamics approach is the time evolutionary view. This allows the representation of the behavior of the system as it evolves through time, giving a dynamic rather than a static view of the system.

Spiritual Dynamics Algorithm of the above Feedback based causal diagram can be represented as:

(01) Conscious Awakening = A FUNCTION OF
(Consciousness Learning Stimuli)

(02) Consciousness Learning Stimuli = A FUNCTION OF
(Consciousness Neurons, Consciousness Genome)

(03) Consciousness Neurons = A FUNCTION OF ("ANN/
Artificial Consciousness Neural Network", Consciousness
Genome, Consciousness Awakening)

(04) Consciousness Genome = A FUNCTION OF ("Genetic
Consciousness Algorithm", Consciousness Neuron,
Consciousness awakening)

(05) "Genetic Consciousness Algorithm" = A FUNCTION OF ("ANN/ Artificial Consciousness Neural Network", Consciousness Awakening)

(06) "ANN/ Artificial Consciousness Neural Network" = A FUNCTION OF ("Genetic Consciousness Algorithm", Consciousness Awakening)

In the above model, an additional treatment of Feed Forward component can bring about a revolutionary insight in developing an experiential learning system for consciousness awakening. (See Figure 3).

It can be assumed here that a feedforward loop of consciousness awakening is basically a open loop on its way. The above diagram shows a self-learning independent stock variable (f =Consciousness awakening) which also temporally depends upon its own past value (say at zero) or the value at one or more other points in time. This very component of feedforward learning structure can be immensely useful in transforming a Decision-maker/ modeler dependent Consciousness SD model into a self-learning and artificially trained decision network system such as envisaged in Artificial Consciousness Neural Network (ACNN) in the following section.

2. Conception of 'Consciousness Neuron' And 'Consciousness Genome' Under System Dynamic Interface

2.1 Artificial Neural Network (ANN)

A growing number of investigators believe that the first step toward a science of consciousness is to discover the neural correlates of consciousness. Indeed, Francis Crick has gone so far as to proclaim that 'we...need to discover the neural correlates of consciousness. For this task the primate visual system seems especially attractive. No longer need one spend time attempting ... to endure the tedium of philosophers perpetually disagreeing with each other. Consciousness is now largely a scientific problem' (Crick, 1996, p. 486). In this connection, **Cognitive neuroscience** is an academic field

concerned with the scientific study of biological mechanisms underlying cognition, with a specific focus on the neural substrates of mental processes and their behavioral manifestations. It addresses the questions of how psychological/cognitive functions are produced by the neural circuitry.

In addition, Connectionist (subsymbolic) approach of cognitive consciousness holds that cognition can only be modeled and explained by using artificial neural network on the level of physical brain properties. Artificial intelligence based artificial neural network-popularly coined as ANN or NN (Neural Network) has lately emerged as a computational model based on biological neural network in the field of dynamic modeling and simulation. The framework of ANN consists of an interconnected group of artificial neurons and which processes information using a connectionist approach to computation. (See Figure 4).

Going beyond the prevailing scientific paradigm considering information processing inside the central nervous system as occurring through hierarchically organized and interconnected neural networks (For instance, the visual information is firstly hierarchically processed at the level of retina (from the photoreceptor rods and cones, to the ganglion cells), to be then hierarchically proceeded within the levels of primary, secondary, and tertiary sensory and interpretatory cortical regions), we could have the similar conception of structural Interconnectedness generalized to understand and describe the Spiritual-physical system.

A structural neural pattern might be conceived to exist for a cognitive-physical system in the human brain where the theoretic existence of '**Conscious neurons**' can be conceptualized in the gray and white matter of human brain, which could have a hierarchical pattern of interconnectedness within and outside the cerebral cortex of a human brain.

The hypothesis of **conscious neurons** is based on the metaphoric premise of existence of electromagnetic force in the physical world. As Electromagnetic fields by contrast are regarded as real and independent parts of our physical world and even though one may sometimes be able to specify the values of such a field by appeal to the behavior of particles in

it, the fields themselves are regarded as concrete constituents of reality and not merely as abstractions or sets of relations among particles. Similarly one could regard “consciousness” or “Conscious neurons” as referring to a component or aspect of reality that manifests itself in conscious states but is more than merely the abstract nominalization of the adjective “conscious” applied to them.

Conscious neuron may be like a light or photon like entity- a superluminal (photogenic/ photonic) particle (**See Figure 5**) having dynamic motions inside the gray-white matter. This conception of spiritual neuron is based on the premise that outer brain/ cortical neural arrangement may have followed a kind of reflective developmental pattern as a ‘microcosm’ of what understandably would exist in the form of conscious neurons inside the inner brain matter (**See Grey-White: Figure 6**) as a ‘macrocosm’.

(Note: In the central nervous system, the “grey matter” is composed of the neuron’s cell bodies and their dense network of dendrites. The grey matter includes the centre of the spinal cord and the thin outer layer of the cerebral hemispheres, commonly known as the cortex. The white matter consists of the myelin sheathing that covers the axons of these same neurons to enable them to conduct nerve impulses more rapidly. These myelinated axons are grouped into bundles (the equivalent of nerves) that make connections with other groups of neurons).

The reference of ‘**conscious neuron**’ like entity dates back to vedic time period some 5,000 years ago in the Indus-Sarasvati civilization of northern India elaborated in the **Patanjali yoga thesis-**

Vrttayah pancatayyah klista aklistah. /5/

(Vrttayah = movements of the thought, pancatayyah = fold five (5) in the neurons of the brain, klista = which give pain in the neurons of brain ,aklistah = which give relief of pain in the neurons of brain.)

2.2 Translation of original yoga thesis

The fold five (5) in the neurons of the brain carry the movements of the thought, which give the pain or the relief of the pain in the neurons of the brain. /5/.

According to the yoga thesis- “The person who has mastered the art of controlling his movements of the thought in the fold five (5) in the neurons of brain and has also mastered the spiritual knowledge that movements of the thought in the fold five (5) in the neurons of brain provoke pain, such person happily undergoes even the pain which is destined for him and which he has brought upon himself by his past karma deeds.” He continues to emphasis- “once a person knows how to penetrate in the conscious state of the neurons of brain, he enters the residence of the formless inner world of inner nature essence. From the gateway of the conscious state of the neurons of brain begins the definite, certain and assured road leading to the gateway of the formless core nature essence and soul essence through conscious state of the neurons of brain”.

Incidentally, very recently, ‘Nature’ (USA) has reported that researchers in Psychiatry Department at the University of Oxford, UK have identified low frequency brain waves emanating from two regions buried deep within the brain sending binary neural response signaling either pain or no pain (Relief of pain). According to them, the signal could be used to refine pain relief techniques that involve stimulating brain with electricity.”

We may therefore comfortably conceptualize this hierarchical interconnectedness of cognitive-physical neural network within the inner-outer sphere of a human brain i.e. Cerebral Cortex. Although the exactness of the number of conscious neurons, their placement pattern and the number of synaptic connections that they might have; are obviously very complicated domains for further scientific explorations.

Nevertheless, following the architect and biomechanics of human brain, one can easily accept the dynamic possibilities of exciting, inducing or setting kinetic these conscious-physical neurons though the performance of concentration meditation practices, prescribed in the religion of saints for the awakening

of a somewhat dormant conscious-physical dynamics inside a human brain and transforming it into a consciously enlightened SUPERNBRAIN. The concentration meditation practice would set kinetic the dormant conscious neurons raising the consciousness from the resting potential level to beyond the threshold level (in case of cerebral neurons, value is above -70 mV) – **See Figure 7.**

Enhancing and Reaching up to the synaptic potential above the threshold level is close to the state of **“Trance” or complete consciousness** as referred in the various religious literature. Moreover, it is verified thought the training of Artificial Neural Network that certain neurons can be artificially loaded with significant synaptic weights in order to activate them towards a desirable optimum output goal. These induced changes in synaptic strength can be of both short-term (Short Term Potentiation -STP) or long-term (Long term potentiation -LTP). Similarly, consciousness neurons can be rendered ‘active’ by constant concentration training (meditation) towards the desirable optimum goal of consciousness awakening or absolute consciousness in the trance state of mind.

It may be noted that in the process of meditation, repeated or continuous synaptic activation (Learning algorithm in ANN) can result in alteration of the structure of synapse itself and hence brings about a permanent and radical change in the consciousness and awakening via a neural mechanism of **synaptic plasticity.**

It can be safely inferred here that as an external stimulating technology (which can be coined as **Artificial Consciousness Neural Network-ACNN**, ANN offers remarkable opportunity for developing a feed forward enabled experiential Learning system of a complex system like one conceived here as conscio-physical system by mimicking the neural patterns of human brain. Specializing in feed forward assisted experiential knowledge; a neural network (ACNN) can store and expand its knowledge base via strikingly human routes-through a synthetic learning process and information storage involving interconnection strengths of synaptic weights. In this regard, one of the most significant concepts in

the field of neural networks is the Hebb's biological learning law, according to which the more frequently activated synapses strengthen, while those ones less frequently activated weaken. In neurocomputing this rule is known as a Hebb's learning rule.

One another very significant advantage of activating consciousness synapse can be explained as 'Summation Process'. Here, the extensive mutual networking of neural synapses of an activated bunch of consciousness neurons and their corresponding synapses can also awaken 'weak neurons' having dormant or very low synapse not reaching to the threshold for action potential initiation. It can be facilitated by a simultaneous firing or bursts of action potentials of trained and activated consciousness neurons initiating "awakening impulse' in their cells where neural synapses are weak, dormant or even dead.

However, the understanding of nonlinear dynamics in neural circuits by theoretical, computational and experimental means is essentially required for the purpose. This type of study should also concern with the nonlinearities at synaptic, cellular and network levels. Moreover, the role of synchronization as carrier of information with respect to global activity patterns in the brain should also be addressed.

These good properties of Cognitive-physical ANN neural networks can inspire many investigators to offer solutions for most problems with sufficiently big network and adequate training by finding corresponding network topology and training rules for every particular task.

Thus, significantly, ACNN can serve as an adaptive artificial consciousness networking system which can change its structure based on external or internal information that flows through the network during its learning phase stretched over a dynamics time-track. it can thus be concluded that the use of ANN to understand, construct and train a conscious-physical neural system can be greatly advantageous to emulate brain functions going metaphysical (beyond physical neural constraints) in explaining the dynamics of awakening of dormant conscious forces contained within.

2.3 Genetic Algorithm (GA)

Francis Crick, co-discoverer of molecular sequence of nucleic acid had once said that “You are nothing but a pack of neurons”, in his discussion about the neural underpinnings of consciousness. Now it is established that neurons are basically the expressions of genes (Inter-connectionist dynamics; as depicted under System Dynamics diagram **Figure 2**) and hence, the building blocks of brain including consciousness neurons. Recent advances in the emerging field of imaging genetics have demonstrated a much tighter link between genetic makeup and the functioning of brain and mind. Genes control the development of neurons to make up brains, but they also govern neuronal gene expression during our daily lives.

Genetic Psychology is the idea of explaining minds and consciousness in terms of genetics. Researchers at the University of North Carolina at Chapel Hill have discovered that commonly occurring variations of a gene trigger a domino effect in chronic pain disorders. (Science & Consciousness review, Dec 2006 et al.).

2.4 Consciousness Gene

Dr. D. Jones (Jones, David; 2000 et al.) has speculated in *Nature* “if consciousness is a definite, inheritable characteristic, it must have had survival value for it to evolve. It then follows that consciousness must be en-coded somewhere in our genes. Only a single gene may be enough, for consciousness seems to be an uncomplicated phenomenon....we can determine for certain if any of the *lower* animals are also conscious”.

Genes are virtually responsible for every step of the neurotransmitter cycle, including the formation, transport, pre-synaptic expression and post-synaptic reception of the transmitter. Genes thus operate at every level of the neural process. They can indeed be treated like fundamental building blocks for both the structure and the functioning of the brain. They set the stage for how neurons and functional groups of neurons act in response to different inputs. A SD-segmented

diagrammatic representation of such inter-connection can be shown as in Figure 8.

Genes are therefore fundamental for the way we experience, think and behave. Therefore, based on the above postulate, we can safely move from ANCN into the domain of Genetic Algorithm-another affiliate of systems science.

DNA has been reported to emit electromagnetic radiation (photons) in the microwave spectrum (1-4 billion cycles per second derived from the electricity that is flowing through our nervous system and spinal cord) and hence it may also carry a message to the consciousness neurons having photon receptors or neurotransmitter receptors through 'electrical synapses' which exist much less in number than chemical synapses in the neural arrangement but are more reliable. (Depicted as Genome-Neuron loop in the Consciousness System dynamic Stock-Flow diagram Figure 7-8 earlier). This would conceivably build a tunnel of DNA-Photon exchange through Cognitive-Cerebral gateway.

On the other hand, altering the DNA genome to create a perfect compatibility of a human physical system with that of the spiritual system might be another very exciting field of scientific exploration going by the same premise of Microcosm-Macrocosm theory as elaborated in the faith of saints. What it suggests to have in a human physical body is those genotype-phenotype patterns of DNA, which can emit a radiation of higher order building an inseparable communion with the consciousness photons (neurons) thus evolving into a consciously **SUPERGENOME**.

The basic postulate of GA is that a genetic pool of a given population potentially contains the solution, or a better solution, to a given adaptive problem i.e. evolution of Spiritually super MAN. This solution is not "active" because the genetic combination on which it relies is split between several subjects. Only the association of different genomes can lead to the solution. No subject has such a genome, but during reproduction, crossover or unconventionally through Mutations, new genetic combination occurs and, finally, a subject can inherit a "Super gene" from parents. In molecular biology, "recombination" can also refer to artificial and

deliberate recombination of disparate pieces of DNA, often from different organisms, creating what is called Recombinant Gene. At the beginning of normal, meiosis chromosome pair (made up of a chromosome from the mother and a chromosome from the father) intertwine and exchange sections or fragments of chromosome. The pair then breaks apart to form two chromosomes with a new combination of genes that differs from the combination supplied by the parents. Through this process of recombining genes, organisms can produce offspring with new combinations of maternal and paternal traits that may contribute to or enhance survival.

The evolution of genetic algorithms can be sequentially presented as -

- Encoding of the problem in a binary string.
- Random generation of a population. This one includes a genetic pool representing a group of possible solutions.
- Reckoning of a fitness value for each subject. It will directly depend on the distance to the optimum.
- Selection of the subjects that will mate according to their share in the population global fitness.
- Genomes crossover and mutations.
- Start again from point 3.

John Holland (University of Michigan, *Adaptation in Natural and Artificial System, 1975* has propounded a method known as 'Holland method' which is especially effective in this context because he not only considered the role of mutation but he also utilized genetic recombination, (crossover): this recombination, the crossover of partial solutions greatly improve the capability of the algorithm to approach, and eventually find, the optimum.

As an example, we may create a simplified genetic map for our 'Consciousness Genome'. The "chromosomes" encode a group of linked features. "Genes" encode the activation or deactivation of a feature. Let us examine the global genetic pool of human race classified in to four groups- **A, B, C & D**. We will consider the "chromosomes" which encode the

characteristics of selected population members. The physical, Intellectual, Emotional and Consciousness characteristics are encoded by four genes.

The ideal genome (of very high **Physical, Intellectual, Emotional and Consciousness Quotient**) may be termed as **Super Consciousness Genome** and can be represented as in Figure 9.

In the taken example, the genetic pool of our population comprised of ABCD is-





Subject	Genome
A	
B	
C	
D	

Table 1

The fitness is computed by giving one point to each gene corresponding to the ideal genome. The perfect genome will then get four points. The probability of reproduction of a given subject will directly depend on this value. In our case, we'll get the following results:

Subject	Fitness	Reproduction probability
A	1	$1/7 = 0.143$
B	1	$1/7 = 0.143$
C	2	$2/7 = 0.286$
D	3	$3/7 = 0.428$
Total	7	$7/7=1$

Table 2

We can now consider a cycle of reproduction and crossover. D will be selected four times (being closure to the ideal) and will then get four descendants. C will be selected twice and will get two descendants. Finally A and B will only be selected once.

The reproduction pattern can be generated as in the following:







Subject	Received genes	Genome				Fitness	Reproduction probability
A'	A : P D : E	P		E		2	2/10=0.2
B'	B : I D : E		I	E		2	2/10=0.2
C'	D : PI C : S	P	I	C		3	3/10=0.3
D'	C : S D : IE		I	E	C	3	3/10=0.3
Total						10	10/10=1

Table 3

During reproduction, crossovers occur at a random places (center of the genome for A', B' and C', just after the first gene for D'). The link existing between the degree of adaptation and the probability of reproduction leads to a trend to the rise of the average fitness of the population. In our case, it jumps from 7 to 10.

During the following cycle of reproduction, C' and D' will have a common descendant: leading to evolution of a **SUPERGENOME (See Figure 10).**

The new subject has thus inherited the intended genome of **High Physical, Intellectual, Emotional and Consciousness Quotient.**

Crossover is the basis of genetic algorithms but the possibility of mutation is also very exciting as it can greatly reduce the transition time taken to evolve a super genome

through a natural selection and crossover period. In fact, the desired solution may happen not to be present inside a given genetic pool, even a large one. Mutations allow the emergence of new genetic configurations, which, by widening the pool improve the chances to find the optimal solution.

3. Conclusions

System Dynamics, Neural Networking and Genetic Algorithm have the potential of approximating the behavior of extremely complex systems such as being encountered in Cognitive-physical system. The above deliberated system approach based interfaces between SD, ANN and GA offer a tremendous opportunity of explaining the dynamics of such system through their connectionist approaches that may also be quite instrumental in developing an Experiential Learning System for attaining cognitive consciousness of high order.

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Captions for figures:

Figure 1: A typical Stock-Flow Diagram with adjoining Feedback loop.

Figure 2: Consciousness System Dynamics Stock-Flow Diagram.

Figure 3: Feed Forward Consciousness Awakening Diagram

Figure4:Artificial Neural Network Basic Framework /Architecture

Figure.5: Conscious Neuron-An Artistic Impression

Figure.6 (a) & (b): White –Grey Matter

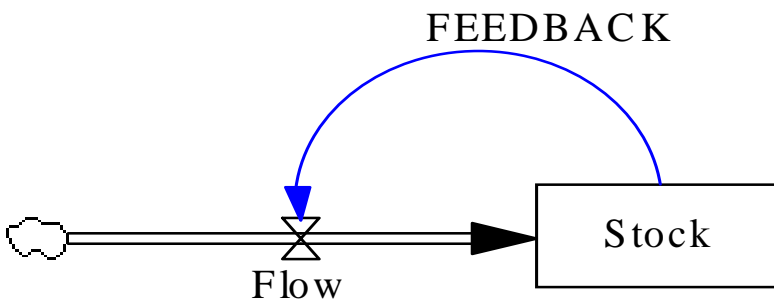
Figure 7: Cerebral Neurons Resting Potential level & Activation

Figure-8 Genome-Neuron Exchange Process

Figure 9: Proposed Super Consciousness Genome Structure

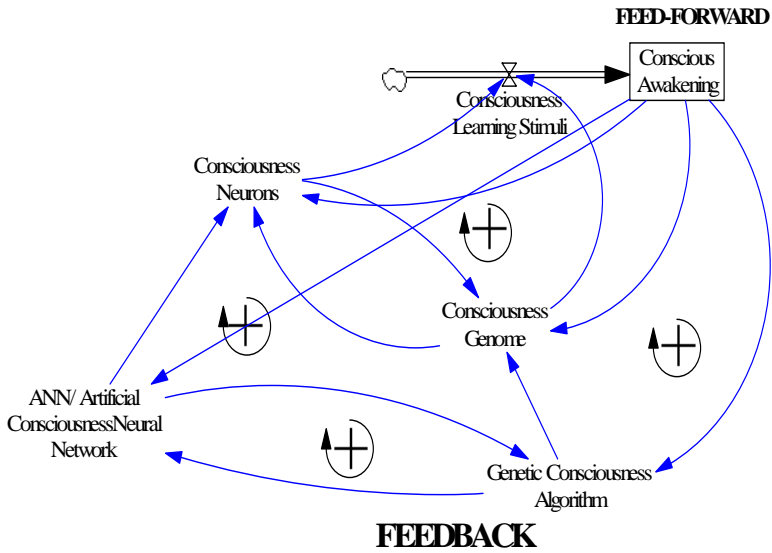
Figure 10: Super Conscious Genome Formation

Figure 1



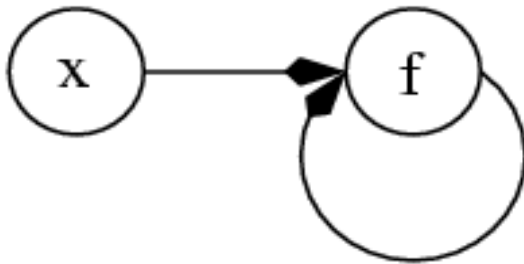
Typical Stock-Flow Diagram

Figure 2



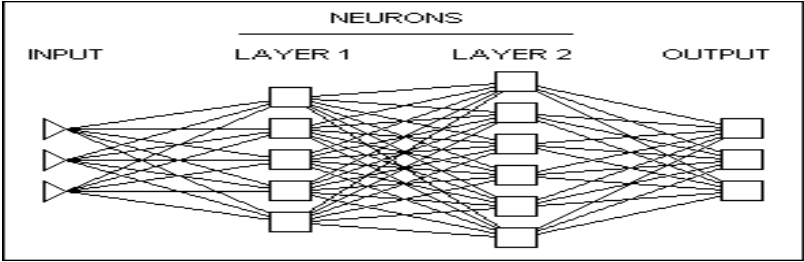
Consciousness System Dynamics Stock-Flow Diagram

Figure 3



Feed Forward Consciousness Awakening

Figure.4



Artificial Neural Network Basic Framework

Figure.5



Conscious Neuron-An Artistic Impression

Figure.6 (a)

White Matter

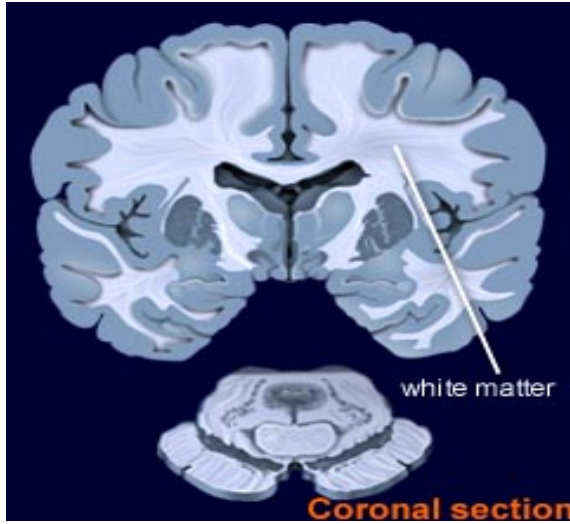


Figure.6 (b)

Grey Matter

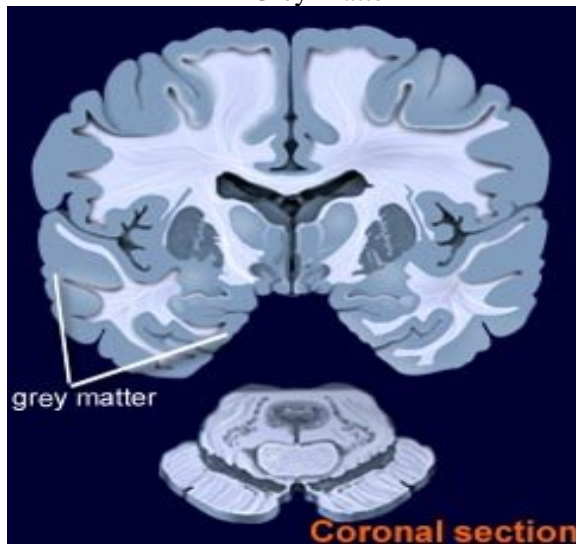
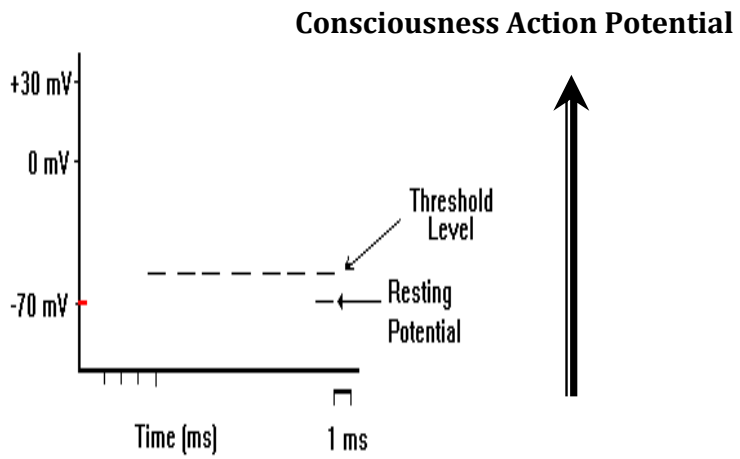
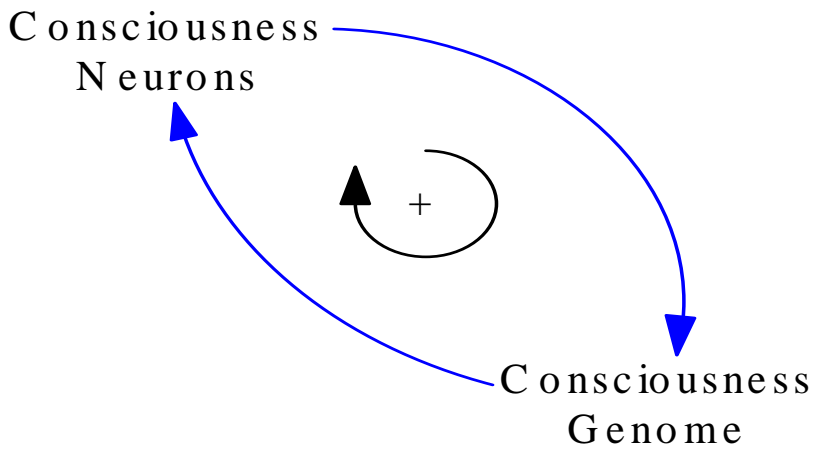


Figure 7



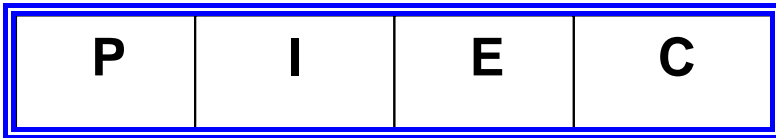
Cerebral Neurons Resting Potential level & Activation

Figure 8



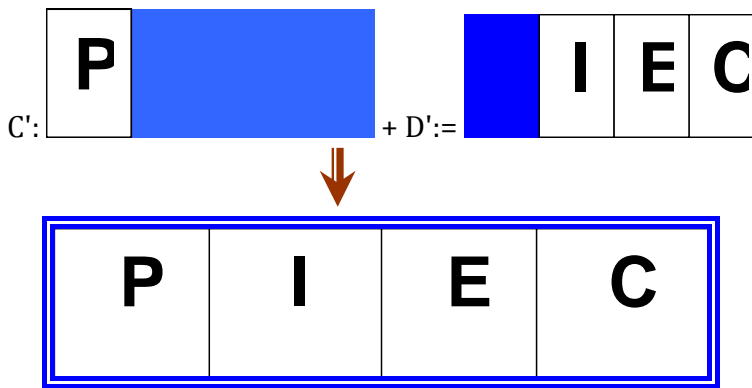
Genome-Neuron Exchange Process

Figure 9



Proposed Super Consciousness Genome

Figure 10



Super Conscious Genome Formation