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Artificial Intelligence, Human Intelligence and Intelligence of Nature: Difficult Questions in their Ambitious Fusion

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Abstract

There are several difficult questions in ambitious project of fusion between psychology and intelligent robotics. What human beings can do that an intelligent robot cannot? What intelligent robots can do but human beings cannot? Why are we not intelligent robots? Why it is so difficult to have intelligent robots with faculty of humanness? What could be the interface of dialogue between artificial intelligence scientist and psychologists? How can we make any advancement in present day artificial intelligence taking lesson from intelligence of nature? The paper discusses all such issues, identifies difficult questions from both sides and shows a modest way of progress by identifying the layers one has to go through; layers between neuroscience and consciousness, layers in cloud computation, layers between signals and wisdom, and the operations therein. It also advances ideas in selection of intelligent robot making material including its sensor development. The paper concludes with a holistic take overarching science humanity and spirit (consciousness).

Keywords: Consciousness; Artificial Intelligence; Human Intelligence; Layers in between; Their Fusion; Emerging Paradigm

Abbreviations: AI: Artificial Intelligence; ATP: Adenosine Triphosphate; BISS: Biologically Inspired Systems Science; CEO: Chief Executive Officer; CNS: Central Nervous System; CPU: Central Processing Unit; DNA: Deoxyribonucleic acid; GDP: Gross Domestic Product; GPU: Graphic Processing Unit; MIT: Massachusetts Institute of Technology; ML: Machine Learning; RNA: Ribonucleic acid; TPU: Tensor Processing Unit

1. Introduction

Leonardo da Vinci seeing through the flesh of human body did the painting of human skeleton. da Vinci, who made Mona Lisa's emotion blossom, was also the first to imagine and sketch the picture of an emotionless robot. The source of all three paintings is one extraordinary psyche of a human genius. Intelligent robot is a creation of human intelligence. True, its reality has started conditioning human psyche, but hardly it can overtake human psyche in its composition, operation and its entirety.

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Robots are either meant for repetitive non-intelligent work (Cobot) or for intelligent work (Table 1). In the latter case, it needs computer program, the algorithm of artificial intelligence (AI). For many scientists artificial intelligence is considered as religion and robot is the god! In spite of having such ambition, artificial intelligence is a miniscule of human intelligence. We will see why? We are not intelligent robot because, we possess an organ called psyche! Our psychological faculties are our assets. Human handshakes, face-to-face communication and expert opinion as human will continue to persist in spite of spectacular developments in robotics. There is a difference between a robotic laboratory and a smart laboratory, between a human-machine and a machine that can act partially as human (homo siliciens)! There is a phenomenal difference between landing of man on the surface of moon or mars, and landing of any space shuttle there.

Classification of Robots
I. Robot which does repetitive work
Cobot
II. Intelligent Robots (AI + Robotics)
1. Almost autonomous robots
Driverless car
Driverless ship
2. Tele-robot
Drone
Anti submarine sea-hunter
Bomb-disposal robot
Satellite
3. Humanoid robots
Receptionist in Banks
Sex-robot
Kismet robot for displaying facial expression of emotion
4. Game-playing AI
Deep blue super computer of IBM
(had beaten chess master Garry Kasparov in 1997)
Alphago of Deep Mind Company
(had defeated Lee Sedol, 3 -1 in 2014)
Google's Alphago
(had defeated Lee Sedol, 5 -1 in 2016)
5. Robots in Medical discipline
Drug delivery robot
Micro robot used in micro surgery
6. Miscellaneous
Pymetrics (Next generation carrier search platform)
Bomb-disposal robot

Table 1: *Classification of Robots.*

The disciplines of AI and Psychology are, however, not on a warpath. Both the disciplines are awe-struck looking at each other; respective complexity, missing elements in each other, achievements and limitations of mechanical and live-systems and therefore, their respective aspiration!

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2. Supremacy of AI over Human Intelligence

At present the essential engineering in intelligent robotics lies in its programming for hierarchical control of error-free behavior of the systems with appropriate sensors, which detect and act at critical level of instability through feed back and often feed forward (?) loops. This programming of the hierarchical systems has reached such a height (Table 1) that in addition to almost autonomous driverless car or driverless ship for large scale ocean transport and the tele-robots such as drones, antisubmarine sea hunter or a bomb-disposal robot that was used to kill Dallas shooter in July 2016, there are origami robots for drug delivery in patients, modular magnetic micro robot used for microsurgery (http://www.livescience.com/topics/robots) or kismet robot, as designed by Cybthia Breazeal of MIT, and programmed for interacting with facial expression of emotion appropriately in response to human emotion following there is eye contact with this humanoid.

Supremacy of AI over human intelligence is also observed in games. In 1997 Deep Blue supercomputer of IBM had beaten world chess champion Garry Kasparov. Alpha Go system of Artificial Intelligence of Deep Mind Company has defeated the champion Lee Sedol (3-0) in Chinese board Go-game in 2014. In 2016, Google's AI, AlphaGo has defeated (5-1) this Go-genius Lee Sedol again. However, the point which emerged from the game that the computer could not change its strategy for the game based on past experience of its defeat or win! Lee Sedol could!

This indicates sturdiness of fixed-logic closed circuit signal-based automated program with incredible memory search and retrieval ability in contrast to vulnerability of human mind, which by nature is slow, has limited memory but incredible openness. It has also been argued that such AI device might compete with human being for a job but cannot replace him since it has no intention to win or lose a game, no feelings following win or defeat, or any will to improve on further [1]! Cognitive intention, feelings and will are recognized functions of consciousness.

To say the latest, "artificial skin gives robots a sense of touch similar to humans'' [2]. Jonathan Posner from Washington University and his team have succeeded to do it! Following this, robot capable of roadside bombs disposal with the same dexterity as we human being do might soon be a reality.

The human mind is also allured for invention of intentional expert system, which can negotiate, and at opportune moment can execute a stunning decision.

3. Ingenuity of Human Intelligence

Human being is endowed with an evolved and sound psyche. AI is an amplification of human ingenuity. Also, it is the human being having expertise and experience in signal coding does all programming in intelligent robotics; encoding, recoding and decoding in hierarchical systems. It is necessary to recognize the organ, the systems psyche of the programmer, which is alive and plays the crucial role in this programming.

The systems psyche [3] in any living organism consists of information, mind, self, life and consciousness! All five constituents are autonomous, non-observable, non-measurable, non-reducible and not-localizable entities executing their influences on the behavior of the systems. They operate from beyond Planck's scale of nature to work on the signals within Planck's scale of nature. This cognitive organ, the systems psyche, could be considered as the pinnacle of evolutionary achievement in human being. Human being essentially differs from an intelligent robot in his wide range of activities and behavior with openness mixed with an element of fragility of this natural gift of psyche, which has been nurtured by education and culture.

Human intelligence is incredible in its width and depth, in its quality, variety and spectrum. It is almost inexhaustible limited by its infrastructure, another incredible gift of nature what we call brain.

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While developing AI, only limited and some known functions of mind and self have been mechanized, although in an error-free manner and with increasing speed. Functions of self and mind have evolved incredibly in human being because of presence of 'life' and consciousness, which operate on a live infrastructure of hundred billions neurons. These are totally absent in any intelligent robot. 'Life' has an open-access activity since it communicates with infinite space. Infrastructure is its limitation for manifestation of consciousness. In the human brain, neural networks are live-wares. Hundred billion neurons and two to ten times of that glial cell are alive. The synapses are tripartite with astrocytes involved in communication. No such modulation of signals in synapses by living cells has been so far made possible in neural network of artificial intelligence.

4. Intelligence of Nature and Human Psyche

Human intelligence is the outcome of interaction between self and mind on the background of memory, both semantic and episodic. This happens in live-situation on the canvas of consciousness. When we use the adjective "artificial" for intelligence we work on the basis of an assumption that there is "natural" intelligence as well! Manifest natural intelligence is observed in biology, in life forms. However, natural scientists have a firm belief that there is intelligence within nature too. This intelligence surfaces from deeper nest/ recess of nature. This deep recess is far deeper than the nature we know as governed by classical and quantum rules. This recess of nature might be in sub-quantum or sub-sub-quantum nature. Intelligence is supposed to emerge from there to take care of quantum puzzles and paradoxes and the laws as we see in quantum and classical nests of nature. Operators of intelligence operate from such deep recess of nature. And, these operators within this deep recess of nature are embodied in systems psyche of all life forms including human beings. Therefore, there is a natural connection between deep ecology and depth psychology, the essence of the Multiversity (The Multiversity is the highest intellectually comprehensible systems of multiple universe) and human consciousness.

5. Humanoid robot is not Human being!

Human being is not Robot!

Humanoids or intelligent robots cannot be human! Humanoid has been used as receptionist in a public place like banks to address frequently asked questions. This has taken into consideration of all advantages what the robot has! Robot has a hierarchically structured signal processing systems, which, unlike in human, is error-free, often faster than human mind. Robot has semantic memory with capacity in a specific context far more than human being. It can often perform complex task faster than we do! It may do it in a far cozier way than a human does (for example, in sex-robot). With the help of AI in Pymetrics, next generation career search platform [4] founder Frida Polli and Julie Yoo have been breaking into the world of human resources getting rid of several unconscious bias such as class, cast, race, gender and age during resume screening. We can send robot where human being cannot go, for example, a life-less robot can be sent in search of signs of 'life' in Mars!

Robot has no life. In absence of life, operations of mind and self are not developed to that extent as we see it developed even in a cell, microbe, or in yeast. Intelligent robot cannot sense any of the five senses human have. Sensation is not there! How can we expect 'common sense' from such an intelligent robot? Even 'mentation' is not there. Robot cannot think! Robot does not have the sense of its whole and its parts. Self-organization, if any, is limited to one or two parameters or patterns. Since life is not there, robot cannot feel or experience. Intelligent robot cannot organize experience into behavior. Robot does not have emotion or feelings. The intelligent robot I use does not miss me, if I am away for a day! It doesn't mind being used even by whom I consider my enemy, who has stolen my password! Robot does not have episodic memory. Intelligent robot cannot choose an option outside algorithmic pre-specifications. Such robot cannot learn from its mistake. Intelligent robot does not have ability to manage unexpected uncertainty. Such robot has no 'will' of its own. It cannot volunteer! Neither it could be pushed to the threshold of intuition and discovery! In the ladder of cognition, a signal-based mechanical robot or an artificially empowered intelligent robot continue to stay at the physical level until we start working on developing bio-hybrid robot, amalgam of biology and material science and develop psychological faculty, even to some extent, in robots! Robot does not have heart. It does not breathe. It does not have liver or kidney. It does not have brain. It is run by scientist's brain! These all are to our great advantage. It has no boredom in its repetitive or intelligent work. Except technical snag, robot does not

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suffer from heart attack, psychological disorders like anxiety, stress and depression, or respiratory distress, renal failure or liver failure. A feminine sex robot will never have gynecological disorders or apprehension of getting pregnant. There is no issue of values and ethics ever. AI is neither ethical, nor non-ethical. Its handler, the human being only determines whether it is a boon or a bane!

On the other side, we are also not biological robots [5]! Besides our organ systems, and live body, which are prone to have several diseases, we work with an endless entity called mind. The mind works under supervision of a self which, although is the only 'particulate' constituent of the psyche, is categorically identical with consciousness and works with a number of options. We make mistakes. We learn from our mistake. In addition to semantic memory, we have episodic memory. We can manage unexpected uncertainty. We have choice! All life forms are in sync with the "principles of life" spread all over the fabric of the universe. Our systems-bound life is in communion with 'life-principle' in the environment, 'life' distributed over the fabrics of our universe or even multiple universe (s), the multiverse! Our consciousness within the brain is operationally in sync with brain-independent consciousness in the cosmos. Through this organ psyche, we are ever open. We can feel, experience, choose and decide. We can be curious, we can imagine, intuit and get illumined. We have will! We can renew our systems consciousness. Accessing the operation of systems-independent consciousness we can redefine our systems operations. We can reinvent ourselves by realizing systems-independent consciousness within the systems.

6. Psychologists and Robot Scientists

Questions for each other

The questions that AI and robot scientists prefer to ask a psychologist or psychobiologist are as under. (i) Show us one property of what you call 'mind', which we have not been able to embody within an intelligent robot of our latest feat! (ii) Tell us one property of what you call 'self' that is not in our latest intelligent robot! (iii) What makes the storage of coded signals in silicon chip and storage of information in DNA chip different? Why amongst all bio-molecules, one prefers DNA as chip? (iv) There are several properties of 'life', which we are not able to embody within an intelligent robot. Could you mention one property of 'life' that could make a real breakthrough in AI and intelligent robotics? (v) We admit that we have failed to produce a conscious robot/artifact. Can you suggest how to move forward for this ambitious fusion?

The questions that a psychologist prefers to ask an intelligent-robot scientist are as follows. (i) Can an intelligent robot distinguish information from a signal, data or even big data and extract meaning out of it? (ii) Can an intelligent robot build up a knowledge base from the pool of several interrelated information? (iii) What does an intelligent robot store as memory; signals, information, knowledge or experience? (iv) Can an intelligent robot feel, become emotional, and experience and learn from its mistake? (v) Can ever an intelligent robot choose an option beyond algorithmic pre-specifications? Does it have a will and volition? Can it learn?

We can frame these questions in other way also. Can an intelligent robot convert a signal into information and vice versa? Can this informative knowledge in robot's possession be converted into formative knowledge? Can a robot have transformative knowledge, a kind of knowledge, which by its very presence transform knowledge of another systems? Simply, can a robot choose out of bounds of its algorithmic pre-specifications an option, which it thinks wiser than what all are within its options? Finally, can a robot have the capacity to feel? Does it have skill to direct the feelings into action? Can it have its own will, which with skill can be put into understandable classical mechanical or quantum mechanical wheel?

7. Psychologists and Robot Scientists

Answers for each other

7.1. The Basics

It is said that the answer could be found in the question itself. Basically, we are looking for operations that convert signal into information, information into knowledge, knowledge into experience and experience into wisdom. Following this linguistic ladder and operations therein, we might get the answers we are seeking. In this context the author refers to his two earlier publications, which have

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deliberations on such issue; on the ladder of cognition [6] and systems engineering for developing a conscious ware [7]. At present, we are stuck with signal processing software programming. We have wonderful innovations in signal processing. We have developed neural network, central processing unit (CPU), graphic processing unit (GPU), tensor processing unit (TPU), cloud TPU and quantum computing (which takes advantage of the strange ability of subatomic particles to exist in more than one states). The leap we are looking forward to is incorporating some of the properties of information-processing mind in developing 'mind'-ware, incorporating some of the properties of knowledge-formatting self in developing an intelligent-ware, increasing the number of logic gates in the processing systems as found in our 'live'-ware so that there are options of choosing beyond algorithmic pre-specifications! Finally, the scientists are playing with the idea, how to bring the systems in sync with the world to have its own will? The cardinal differences between hierarchically organized different artificial wares are shown in the following table (Table 2).

	Software	**Mind-ware**	**Intelligent ware**	**Live-ware**	**Conscious-ware**
Deals with	Signal	Signal and Information	Signal, Information and Phenomenon	Uncertainty and Symmetry homeostasis	Within-without synchronization of the systems
Operation	Operates on the basis of algorithmic pre-specifications	Operates by extracting meaning out of signal	At critical point takes decision over a number of given options	Operates with ability to choose outside algorithmic pre-specifications	Operates on the basis of its own will
Logic gate	One or two in number	A number of logic gates	Any one of the logic gates may be made to function endlessly to produce pattern within pattern ad infinitum.	Could do self-modification of logic gates	New logic gate appearing spontaneously within the systems

Table 2: *Characteristics of Different Artificial wares.*

The basic of systems engineering lies in developing operations, hierarchically nested and controlled by appropriate sensors, in consistent with the goal of the whole. Robot might not know the whole and its parts but a robot scientist must be thorough with this. For understanding these operations, we need to look inwards towards non-observable operators within the domain of consciousness. As stated in the systems psyche, those are information, mind, self, 'life' and consciousness. Mind works as an organ of communication between two conscious systems. In human situation operation of mind converts data/signal or space-time construct of information into digital or Shannonian information.

Self carries out this operation of conversion of digital information into Gödelian information. Self is the chief executive officer (CEO) of consciousness within the systems. Self is that which provokes the sense of 'I', 'Me' and 'Mine'. Transformation of digital information into Gödelian information is essentially formatting of information in the context of the whole and to achieve an invariant symmetry. Having withstood the challenge of symmetry-breaking processes of 'life', formatted knowledge with invariant symmetry could transit to transformative knowledge (experience). Life-operations are relevant here. Experience sublimes into wisdom with involvement of operation of consciousness. Consciousness is that what looks after, and is in-charge of what all is going on in mind, self and 'life' in terms of quality management of information or phenomena. Only active intervention by consciousness could transform system's experience into multi-systems wisdom.

7.2. Response of the Robot Scientist

Therefore, the answers of the robot scientists for questions asked by psychologists are as follows. (i) Intelligent robot cannot distinguish information from signal. Robots work only on signals. Information coded as signal can only be handled by it. (ii) An intelligent robot does not have any knowledge base. It works on the basis of pattern in the signal pool. (iii) Robotic memory is signal-based, only encoded signals. (iv) Cobot or robot does not have emotion, feelings, experience and choice beyond algorithmic specifications. (v)

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Volition and will are very distant dream in robotics. However, open-source hardware engineering, which is going to redefine wireless communication, might be the very primitive step towards how AI can remain in sync with the world.

7.2.1. Machine Learning

An intelligent robot can learn to a reasonable degree! Machine learning (ML) is an advancement of AI where machine learns to become cleverer in real time during data handling. To develop crowd source learning by robots and acquisition of new skill has been in the mind of a few AI scientists who also dream of making intelligent robot free from computing constrain by indulging in cloud robotics [8]. In a dynamic environment learning from range data that a mobile robot maps, has been in pursuance for some time [9]. ML is a huge engineering feat with technology like big data analysis, GPU, TPU and clouds TPU. Identification of car, identification of human being, identification of hand-writing, tracing of missing child considering the possible change of image of the child over time are a few examples of machine learning agenda. It is expected that more success in ML could be achieved in bio-hybrid robot!

7.2.2. Biologist's Interjection

We, as living being, can learn by using our mind, self and 'life'. Learning through mind is superficial. Learning through self is episodic. Learning through life is effortless, smooth and lasting. While informational memories are with mind, episodic memories are with self. Self-learning is said to be better than learning by using mind. Learning which is popularly thought to be a psychological process where one learns through mind or at best through self, could also be a biological process when one learns through life. It has been reported [10] that children in Bangalore slums can speak about four to five languages by the time they are five years old. This is an example of learning through life. We see this example also in a biological cell, *Physarum polycephalum*, a kind of unicellular slime mold. The slime mold shows habituation, a definite form of learning [11]. AI and ML are expected to toe a similar line of learning using mind, self and life.

7.3. Response of the Psycho-scientist

The responses of psychologists to the questions, which a robot scientist asks are as follows. (i) One property of mind, which is not yet embodied, is the ability of extraction of meaning out of signal. We do not have any artifact, which can tell us the meaning of any signal. Signal works in AI as meaningless entity. (ii) We do not have any self-organizing robot. The property of self by which the systems can format information into knowledge for the whole is a far cry in artificial intelligence. Transformation of Shannonian information into Gödelian information in any AI device is yet to be achieved. No intelligent robot has the sense of the whole and its parts. (iii) Regarding storage, silicon chip stores coded signals. DNA is storehouse of information. In addition, other bio-molecules, which store information are proteins with secondary (e.g., folded receptor proteins in cell membrane), tertiary (e.g., enzymes) and quaternary (e.g., DNA-repairing enzymes, Perforin etc.) structure, and protein with spherical structure (e.g., histone protein). Microtubular proteins are other examples, which are involved in information storage and transmission.

However, the large capacity of DNA to store information makes it a bio-molecule of choice for its use in hybrid robotics. In this context, attention is also drawn to the packaging pattern of insurmountable quantity of information in biological material like DNA, which could serve as holographic sensor for the cell in combination with nuclear chromatin. There is another yet unrecognized important property of DNA that is related to 'life', which might be explored for recognizing DNA as bio-molecule of choice for intelligent robotics. There are differences between a chemical molecule of DNA and a live DNA molecule! The property could be investigated from the basis of existential differences between DNA as molecule, and live-DNA.

DNA as molecule (might be called dead DNA) could be made to replicate flawlessly several thousand times in a thermocycler machine. However within a living cell it has limited capacity to replicate and that too happens with errors. No machine is there yet which can cause translation of DNA into mRNA. One requires live-milieu for such translation. As soon as one puts DNA in living milieu, DNA-fluidics begins to manifest, which is conspicuous by its absence in the absence of the milieu of a living cell. (iv) Regarding 'life' it is not at all clear what does 'life' mean at this subtle level of signal-information–knowledge-experience transformation. It may be what has been variously labeled as life-principle, principles of life, and properties of life etc.

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One property of life, if properly addressed, could bring a big advancement in intelligent robotics. This is life's homeostatic property at the subtlest level. A living entity executes uncertainty-certainty homeostasis, dark energy-visible energy homeostasis and asymmetry-symmetry homeostasis. All three kinds of homeostasis are interrelated, related to generation of information, breakdown of information (into signal) and role of information in symmetry-breaking and symmetry-making process. The issues have been discussed in my earlier paper [12]. Dark energy constitutes 70% of our universe and it is unlikely that a living entity is totally oblivious of this or totally uninfluenced by this. There is not yet any breakthrough in how to harness this dark energy by biotechnological processes!

For further advancement in AI, we are to follow the ladder of cognition and the operations therein [6]. Following is a figure (Figure 1), which shows this ladder with hierarchical operation in bioinformatics.
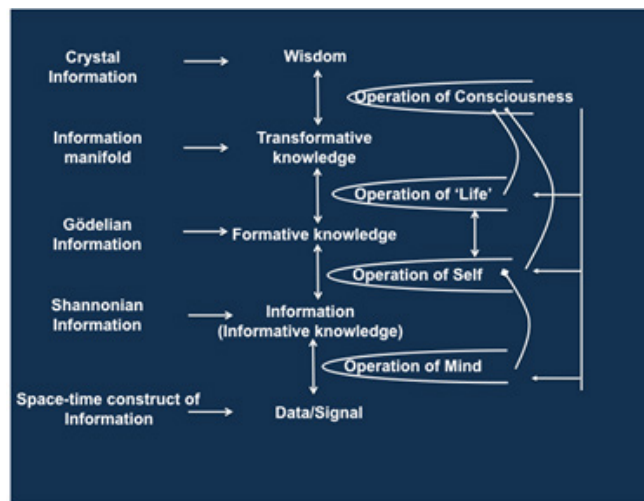

Figure 1: Suggested hierarchical control systems from Signal to Wisdom and Wisdom to Signal.

According to the hierarchy, mind reports to 'self'. Life and 'self' maintains a tangled hierarchy amongst themselves and individually reports to consciousness. Mind feeds back to self and the self in turn feeds back to consciousness. Self and life have instantaneous reciprocal feedback and feed forward control loops. Consciousness has direct hot line connection with mind, self and life. Consciousness feeds forward self, life and mind and gets feed back from all three. Neither consciousness, nor self nor life has any direct communication with signal network or data. This is all via the operation of mind.

Finally psycho-scientist doubts if a robot can ever be independent of its creator scientist? We are on the issue of autonomy in robotics! But how far! In systems biology autonomy has been conferred to those organs, which have achieved the desirable degree of perfection in concurrence with the goal of the systems. Heart has been offered autonomy, lungs, kidney, liver have been given autonomy but not the genital organs or even the hands. Hands and genital organs are left under voluntary control. Generally no creator (God included) offers complete independence to the systems created! Consciousness too, both in its ontological and axiological status, and phenomenological and epistemological operations maintains its absolute independence.

8. AI: Required shift from Neuroscience to Psychology

So far AI has been inspired by behavioral neuroscience [13], although AI differs from blue brain project [14] or the field of neuromorphic computing system [15]. To generate new ideas in the discipline of artificial intelligence we are at the threshold of a leap from neuroscience to psychology, from neurological processes to psychological processes, from Neuro-algorithm to psycho-algorithm in order to achieve a realistic goal for building near human-level AI, where computer will not crash because of pressure of search space!

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Human intelligence is developed from intelligence of nature through the process of biological evolution. In contrast to intelligence of nature, human intelligence is observable, measurable systems-bound intelligence. Artificial intelligence is the outcome of an effort to harvest certain specific human ingenuity in mechanized objective form, guarding against subjective bias and ensuring transparency, often amplifying the capacity in error free manner. Understanding of human psyche, its composition, structure and operations is very important in this regard. The thin line between neuroscience and psychology is required to be identified and explored.

9. Thin layer between Neuroscience and Science of Consciousness

Consciousness has a science of its own with its ontology, axiology, phenomenology and epistemology. This is science *of* consciousness. Operation of consciousness is connected with operations in quantum physics and classical physics. Study of these connections is the science *for* consciousness. The thin layer between neuroscience and science of consciousness is the object of study in science *for* consciousness.

This thin layer is further layered; there are layers within this thin layer and the sub-layers are as follows (Figure 2).
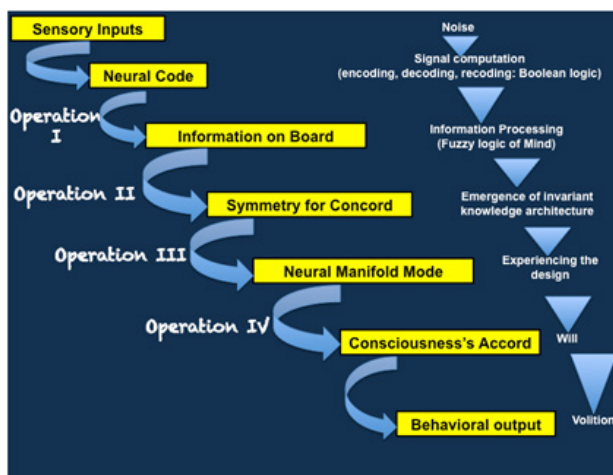
Figure 2: The cascade of events from neural signaling to behavioral output. Several operations are involved in layers. Operation I is that of mind, operation II is that of self, operation III is that of life, operation IV is that of consciousness.

9.1. Sub-layer 1: This is the layer of neural signaling; not intracellular signaling but neuro-neuronal intercellular signaling. Neurons are specialized in this external signaling network because of 'polarity' of their membrane, supported by 'serenity' of genes for which neurons need not multiply frequently and could have stable microtubules. The shift of focus from internal cell signaling to complex external network signaling is the first step towards 'exterior' from interior of the nervous systems.

9.2. Sub-layer 2: This is the layer of Neuro-information. Signal to information and information to signal transformation requires dark energy homeostasis, which could be executed only by living cells. In the central nervous systems (CNS), such cells are astrocytes, which surround the cortical neurons. In synapses of peripheral ganglion or in nuclei of CNS, there is no information transmission! There is only signal transmission. However, in the cerebral cortex where astrocytes constitute cells 2-10 times of that of neurons and the synapse becomes tripartite with involvement of astrocytes in every synapse, there is generation of information and a process of thinking! Astrocytes are also cells, which produce adequate number of ATPs (hard currency of energy) for metabolic utility of neurons! There is a non-observable operation, what in linguistic is called operation of mind. Generated information itself is multi-leveled (multi layered) with its physical measurable facet in the signal domain, content facet in the mental domain and intent facet at the domain of self.

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9.3. Sub-layer 3: This is the layer of Neuro-information-architecture around and over the neurons. Cellular infrastructure for this architecture is again provided by these neuron-astrocyte complex patterns. One astrocyte is in tripartite connections with several thousands synapses, even sometimes across two cerebral hemisphere. Various invariant symmetries of this information architecture in linguistic sense are called knowledge. At the non-observable plane there is an operation conducted by self.

9.4. Sub-layer 4: This is the layer of underlying design; the Neuro-information-architecture design of information manifold supported by neuron-astrocyte manifold. This design maintains the invariance of symmetry of the information architecture. Architecture and design feeds each other, balances and counter balances each other. They maintain a tangled hierarchy in their relationship. Sustainability of design is the handwork of operation of 'life'. Every specific design represents a specific experience of life.

9.5. Sub-layer 5: Signal network, Neuro informatics, information architecture and the underlying design in information manifold operate under tacit support from consciousness in sub-layer 5. The support of consciousness is actively passive. None of signal network, Neuro informatics, information architecture and the design has governing capability. Governing capability comes following 'accord' from the sub-layer 5. In behavioral expression, this is recognized as the 'will' or volition from the systems brain. Consciousness, therefore, is involved in will and choice, and governs the experience, feelings and awareness in the awakened brain. Information and signal comes under the content of this awareness. Self, life and consciousness are involved together in generation of feelings, experience and choice.

Consciousness also brings the systems brain in sync with the external supracortical world. Top down, consciousness governs the systems brain, uses systems brain for its manifestation. Recognition of this phenomenon is the real paradigm shift for neuroscience, where the Power-center is not with the systems brain but with systems consciousness.

9.6. The whole Canvas

The layer of neural signaling, sub-layer 1, is the decorative embroider over the whole canvas. The fabrics of the canvas are layered as sub-layers 2, 3 and 4, where there are operations of mind, self and life. The base of the whole canvas is constituted by the ground consciousness in sub-layer-5. The painter, the nature, knows the value and importance of the layers of fabrics and the ground of the canvas, which supports the signal embroiders.

Consciousness from the boundary of the systems supports the experience of the design within the systems. The design in turn supports the architecture of knowledge for which the algorithm (sub-layer 3) becomes conducive to Neuro-informatics (sub-layer 2) and skilled communication of signals at sub-layer 1 to determine the expressed behavior of the systems. The level of consciousness of the systems determines the level of marvel of the design. Consciousness at the boundary keeps consciousness within systems in sync with consciousness outside.

9.7. Towards Biologically Inspired Systems Science

These layers required to be simulated while we are engaged in making high-level AI and while applying this in robotics. Lessons are to be cultivated from the happenings within the cerebral cortex.

Electronic and communication engineering is to be inspired from functioning of sub-layer 1. Information technology and computational science is to learn from operation in sub-layer 2. How to harness self-organization for creating architectural marvel is to be learnt from sub-layer 3. Self-organization of neuronal proteins at nano and sub-nano level to support the architecture of information is relevant here to fine tune nanotechnology! The knowledge on how life operates to lead the issue of signal to wisdom and vice versa for a logical conclusion and maintaining conformity with the whole to sustain the design at the level of manifold is awaiting a breakthrough in biotechnology; how 'life' harness dark energy. Operation of photon and phonon are relevant for sub-layers 1 and 2. Operation of conformon begins in sub-layer 3, and is most relevant in sub-layer-4. We are completely unaware of operational mechanics for sub-layer 5. However, the author suggests that operation of neutrinos will be more relevant for execution of mechanics from sub-layer 5. Phonon, Photon, Conformon and Neutrino are constituents of information holograph [16].

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10. The leading Frontiers

As said, we are to focus on how can we take help from a biologically inspired systems science (BISS) to develop artificial intelligence and in its application in robotics rather than looking at the individual cell and human body as mechanical systems. The expected breakthrough is hidden in decoding the clue of harnessing the untapped pool of dark energy by means of biotechnology. A fusion of biotechnology, nanotechnology and information technology is on the card when nano scale means really nano and not submicron, when biotechnology could harness dark energy, and information technology can distinguish information from signal and Gödelian information from Shannonian information. In additions, there are five frontiers as mentioned below.

10.1. Extending cloud computing

In understanding cloud computing, material scientist's emphasis and focus is on the server, while natural and consciousness scientists emphasize and focus on the *nature* in between the servers. While the former emphasizes packaging of data within the server, the latter emphasizes packaging of signals and information within the nature. In the first step of extension what scientists of AI have to learn from natural intelligence are how endless number of signals are transmitted in between servers without cross, and in absence of a device receptor like server, how signal manifolds remain packaged within nature eternally. Following this first step, the cascade begins in looking beyond this immediate nature of interplanetary space within solar system into the nature of interstellar space, intergalactic space and inter-universal space. Harold E. Puthoff, Director of the Institute of Advanced Study at Austin had written about engineering this vacuum.

10.2. On basic nature of Material to further AI

What could be the basic nature of the material for developing the hybrid robot (Table 3)? Simplest examples of such hybrid robot are molecular calculator and DNA computer. As robot building material we generally use some physical matter in specific state, for example, silicon rubber, liquid metal, semiconductor chip, or a chemical jelly [17]. Chemical jelly could be hybridized with proteins of different structure and then we can use DNA molecules and DNA within protoplasm. Next step is how we can use a product from a three-D printer, products of synthetic biology and even neuron-glia culture, cultured stem cells, a microbe or an organoid in the hybrid robotics. We are not still sure whether successful 3-D printing of brain [18] has made the problem more complicated or easier! We can also have synthetic biology products as building material! One of our objectives is to bestow freedom on the intelligent robot, as much freedom as we can! The question, therefore, remains which robot whether biophysical hybrid, bio-bio hybrid or synthetic biology product hybridized with natural biological product or print-ready mesh from 3-D visualization of MRI data will have so much freedom as human being we enjoy! We must not forget that what has been missing in such device is the precious systems psyche in its full form!

Building Materials to further AI
1. Physical Material in specific state, liquid metal, silicon rubber etc.
2. Chemical Jelly (one can achieve self-organizing pattern) Ref.: [17]
3. DNA molecules
4. DNA within protoplasm
5. Neuron-glia culture
6. Stem cell culture
7. Organoid
8. 3-D printed brain
9. Specific Microbe
10. Hybrid Robot

Table 3: *Building Materials to further AI.*

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10.3. On developing Sensor to further AI

The sensors, internal and external, are important to control systems for automated operations. Sensor (Table 4) could be specific for a part-operation of the systems. Or, it could be holographic sensor: classical holographic, quantum holographic and as the present author has suggested of information holography in life-situation [16]. The sensors used so far in the robotic systems are physical energy or chemical materials. Many scientists have been working on classical holographic sensor and possible quantum holographic sensor.

Sensor Materials to further AI
I. Sensor for part-operation
Proteins of secondary, tertiary and quaternary structure
II. Holographic sensor
1. Classical holographic sensor
2. Quantum holographic sensor
3. Information holographic sensor (for living state)
(i) DNA
(ii) Spherical proteins such as histone
Packaging pattern of sensor material is equally important.

Table 4: *Sensor Materials to further AI.*

When we go into exploration for possibility of bio-hybrid robots with an aim to harnessing knowledge and experience from operation of 'mind', 'self' and 'life', we are shifting from automated sensor control of material world to sensor-controlled autonomous operations in non-material world (of mind, life, self and consciousness) [8]. In this situation, the importance of information holograph could be more relevant.

The packaging pattern of information in biological material like DNA in combination with nuclear chromatin is relevant here since it could serve as holographic sensor for the cell. Spherical proteins in this context, such as histone of nucleus, are of special importance, which could be used for sensor development. With 'life' in the picture, feed forward alteration by sensors shapes the evolution of the systems.

10.4. The Brain as a whole acts as Sensor

In the context of neuroscience it can be said that the human brain has been evolving to become the sensor for wisdom in nature with the ability to censure noise, irrelevant signal, information, knowledge and experience. In the language of neurobiology this phenomenon demands an overhaul of structural chemistry of proteins inside hundred billion neurons. The packaging pattern is also important as well; packaging of neurons, packaging of glial cell, intracellular packaging of organelles and intranuclear packaging of DNAs and Histones.

10.5. The Brain acts as an organ of manifestation of consciousness

The infrastructure of hundred billion of neurons and their glial cells do not manufacture consciousness. It supports various conscious states. The massive communicating networks and information architecture are all meant for transmission of consciousness. There is only one single conscious agent to handle all perception, knowledge and experience. Recent split-brain revisit by Pinto et al (2017) confirms this single agent [19] for split perception. In supracortical parlance, the dendritic mat and non-synaptic dendritic spines probably act as receptors/antennae for this transmission ordeal. The health state of dendritic spines determines the cognitive resilience against dementia [20].

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11. Six Sigma approach and Lean Manufacturing Principles

Tool for both Robot-scientist and Psychotherapists

Robot technologists are familiar with six-sigma approach and lean manufacturing principles, respectively for elimination of defect and for focusing on time and efficiency in manufacturing. Psychologists are not aware of this approach or principle. Our psyche is an information-hub, a knowledge hub, and an experience hub. It handles information, which is a complex mixture in the spectrum of noise and wisdom. Information-quality delivered by human psyche and information-quality what a robot leaves in its scientist's mind are equally important. The objectives of both robot scientists in creating artificial intelligence and psychotherapists while helping patients are to achieve perfection by dissecting noise from signals, selecting the right information from conflicting signals, formatting inter-related information into appropriate knowledge and strengthening this knowledge into experience through various events of life, and finally to synchronize the experience with the worldview, the wisdom of the world. We must apply this six-sigma approach and lean manufacturing principle in the fields of psychology and healing, and artificial intelligence and robotics.

Consciousness within the psyche is the 'Quality Manager'. Consciousness is that which looks after what all are happening in our life, self and mind for quality information management. We all agree that information too has a quality, which ranges from sigma one (noise) to sigma six (wisdom, world class quality). "Just in time" in lean principles requires topmost perfection with little error, as we certainly observe in wisdom. The objective in robotics is to attain this quality of information in the device. The objective of psycho-therapist is to dissect out wisdom from different kinds of noise within patient's psyche.

12. Perspectives

United Nation Conference Trade and Development report, 2017, has shown that robotics has not eliminated but increased job opportunities in countries like Germany, Mexico and South Korea. AI will not take away job. It will replace task. It will change the job. Many economists are of the opinion that appropriately used, application of AI can double the GDP of most of the countries. Crypto economics is a boon from AI. Robotics itself demands skilled and experienced human resource for its development, manufacturing and maintenance. We are to accept the reality of exponential growth of such industries, which open up unparalleled job opportunities.

The inter-phase of AI and human psychology is as complex as it is between god/demigods and different religions. As said, to many of us AI has become religion and robot the God! The humanity, however, has shifted focus from religion to spirituality and from gods to supreme power of consciousness. Spirituality studies nature of consciousness, and nature in general is the object of study in science too. The humanity has been learning what Sir Isaiah Berlin, the Russian British philosopher and historian of ideas, wrote in 1930s that people could be classified into foxes and hedgehogs. Foxes know many things. Hedgehogs know one important thing, the coherence in the picture and stop not till that is achieved (lateral thinking: examine the difference between cerebral cortex of hedgehog and fox. Examine the spines over the body of hedgehog for their antennae-like properties, if any). In bringing coherence in the complexity, consciousness has a fundamental role. As science for consciousness develops and progresses, so we expect more clarity on the role of operation of mind, self, life and consciousness for hierarchical control of the behavior of live systems. There is great expectation to have progressive co-evolution of human intelligence and AI with all checks and balances set straight by axiology of consciousness.

It is relevant to remind the readers that the Nobel Prize of 2017 to Richard Thaler in behavioral economics has been awarded for his work on the thin line between psychology and economics. The thin line between brain and consciousness, and between psychology and robotics remain as pending challenge!

In the layers of this thin line there are sensors. Appropriate sensor development for hybrid AI is most likely to happen from research on structured protein. Signal is non-intentional. Information is intentional. Knowledge having achieved an invariant symmetry acts as sensor for information. Experience has the ability to censure, in addition. Wisdom is sensor, can censure and it governs. Following this ladder of cognition, primary, secondary, tertiary, quaternary and spherically structured proteins might be explored for

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appropriate sensor development. Brain, as a whole, needs to be recognized as a sensor for wisdom in nature. Six sigma approach and application of lean principles are equally important for both psychology and AI.

Bringing life in robotics at present stage of science seems to be a Herculean task! Life cannot be digitalized! Important pressing issues are quantity of freedom and autonomy of robot, how to bring within robot a sense for the whole and its parts, how to make AI open-ended, how to have a mechanism for meaning extraction from signal and how to cast the whole saga of AI and robotics within fundamental ontology and axiology of operation of consciousness?

Consciousness is being gradually recognized as study subject in mainstream science. Consciousness is yet to be recognized as the ultimate Source-Field of the phenomenal world. In science now, there are plenty of physical scientists, in addition to life-scientists, who acknowledge this fundamental role of human consciousness in science. The present author has published papers on the emerging patterns in complexity and on systems psyche holding nonlocal consciousness as the absolute fundamental. The "hard problem", a creation of human mind, however, stands as stumbling block on the way. As argued in this paper the operating consciousness in the context of the systems brain is not merely supracortical in location. Consciousness operates from a plane deeper than mind. Therefore, as Sri Aurobindo pronounced it is "supramental" as well! The hard issue can be circumvented in science by formulating appropriate questions and specifically addressing those. Bottom-up, the pressing issue is how can one link signal with the wisdom? Top-down, how the "will" of consciousness can naturally get hold of the 'Newtonian wheel' at the classical sensory level? For both the approaches, the ladder of cognition remains the supportive conceptual tool.

13. Concluding Remarks

The emerging paradigm is not lop-sided. It accommodates equally Science Humanity and Spirit in consonance with three fundamental questions well articulated thousands of years back in *Prasna* Upanishad; who am I (addressing Humanity)? What is this world (addressing the goal of Science)? Who is God (i.e., Spirit)? Appropriate growth of AI and robotics is to be pursued in this said direction of emerging paradigm.

Some of the developed countries have become the citadel of modern science. Where do the systems psyche, its structure and operation fit within this wonderful architecture of science so carefully crafted there? In our pursuit of science, we like to carry forward the science of AI at par with the natural intelligence! Natural intelligence, as par excellence, is observed in the wisdom of nature! No human being or man-made device has been ever seen to surpass the wisdom of nature. They can, at best, become 'transmissive' of this wisdom! The purpose of developing AI is to amplify human ingenuity, to enable work force and empower people. It can guard against bias and ensures transparency. The nature, in its entirety, exemplifies the "conscious ware" we are trying to build up through AI.

In our effort to make humanoid par excellence, excelling human being in certain specific ability, we assemble the parts to construct the whole! Look at the steps! We will assemble calcium and phosphate in the osteoid matrix to produce skeleton! We will add flesh on it! We will cover it with sensitive skin! We will develop organs from organoids and transplant the organ in the humanoid! Finally, we will create 100 billion neurons and more number of astrocytes and other glial cells to develop a brain for this humanoid! Like some countries, which are hub for science, there are countries, which are hub of human activists. Their take in AI and robotics is to fully ensure that created robot does not become Frankenstein, not let the robot to control human life! Human intelligence is, and desirably should always remain 'master' of this device. To cultivate this supremacy of human ingenuity it is worthy to make effort to have good grand parents and parents who can give birth to conscientious scientists and technologists and train them in value-based institutions! There is an urgent need of such *Homo spiritualis* populate this earth. *Homo spiritualis* are those whose systems-bound brain consciousness is in sync with systems-independent consciousness in nature.

There are a number of examples of such highly spirited *homo spiritualis* who has already lived their lives on this earth such as Jesus, Mohammed and Zoroaster. In spiritual science, India, the land of the Seers remains the torchbearer. From India the world has seen Buddha, Sankara, Sri Chaitanya and in the recent past, Guru Nanak, Sri Ramakrishna, Sri Aruobindo and Akhandamandaleswar Sri Sri Swami Swarupananda Parmahansa Dev. They are some of the examples of "conscious ware" in real human form!

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In our pursuit of developing "conscious ware" in artificial intelligence we are to take lessons from behavior of nature as well as of such *Homo spiritualis* especially when the systems pass through the phase of critical instability with multiple options at the event horizon. In the learning process from both, the ladder of cognition remains the supportive conceptual tool.

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