# ARTIFICIAL INTELLIGENCE, NEUROSCIENCE AND BEYOND

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**Abstract**

Science and Spirituality often talk of the same subject in different languages and the topic of intelligence is an interesting example. While neuroscience deals with the physical aspects of the brain and its functions, Artificial Intelligence deals with its abstract manifestation. Neither has yet come up with a satisfactory or inclusive coverage of the subject. The Upanishads on the other hand, seem to have comprehended the topic in its essentiality and entirety and dealt with it in different levels. An awareness of their approach can only enhance the overall effectiveness of any science in unraveling the mysteries of nature.

## 1. Introduction

Spirituality and Science are seen by many as two separate entities. Science is that which can be observed, measured, inferred and proved. Spirituality can only be felt, experienced, attained or realized. Science may deal with atoms at one end and galaxies at the other and everything in between, but eventually it will have to lead to the mystery of life if not to God. God and things like soul are the sole property of spirituality at the moment and beyond science, as it is known today.

Concepts like the human brain and its intelligence are somewhat in between and can be approached from both the perspectives. The two opposite views have to necessarily converge at some point since the subject matter is after all the same. The apparent gulf between the two views is essentially caused by the use of different languages and language at best is a peripheral issue in both the realms.

Artificial Intelligence and Neurosciences are the ideal candidates to propound the concept of brain and intelligence from the scientific point of view. If Neurosciences deal with the brain at the physical level, AI deals with Intelligence, its abstract manifestation. Spirituality can then provide the counter-point and Upanishads offer a convenient reference frame. The conclusions after the dialogues can only be subjective and are at best left to the individuals.

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## 2. Artificial Intelligence

Artificial Intelligence (or AI in short) can be variously defined as 'the automation of intelligent behaviour', 'the intelligent behaviour in artifacts', 'the study of mental faculties through the use of computational models', 'the study of computations that make it possible to perceive, reason and act', 'how to make the computer do things at which at the moment, people are better' and 'designing and programming machines to accomplish tasks that people accomplish using their intelligence'. There are several more.

The above statements essentially boil down to one of the four combinations: To make the computer

1. behave like a human being (Turing Test Approach)
2. behave in a rational way (Rational Agent Approach)
3. think like a human being (Cognitive Modeling)
4. think in a rational way (Law of thought approach)

To be human and to be rational are quite different. Thinking and acting are also obviously different.

The Turing Test was suggested by the English mathematician Alan Turing, who first stated in 1950 the conditions for considering a machine to be intelligent [1]. He argued that if a human interrogator, after posting a few written questions to a room in which both a human and a machine were present, cannot tell whether the answers came from the human or the machine, then the machine has 'behaved like a human being'. Similarly, the other approaches have their champions.

Many 'pure' AI scientists do not believe in psychology nor do they like to deal with methods that depend on biological observations. Hence the simulations of *human* thinking or behaving on a computer are dubbed as '*weak* AI methods' while the simulations of *rational* thinking or behaving are given the name of '*strong* AI methods'.

AI has scored certain significant successes in areas traditionally considered to be in the human domain and hence its popularity. Some Airlines use AI's speech recognition systems based on flight numbers and city names. Image processing (computer vision really) is showing a lot of promise in several fields though it is still not as good as what a human can do in many areas. The first expert system MYCIN, developed in 1974, to diagnose bacterial infections of the blood actually did better than several medical students or even practicing doctors. That it had to face legal, moral and ethical issues and was forced to be put in the back-burner was a tragedy. In games like tic-tac-toe or checkers, computers could definitely beat the human champions and in chess, IBM's Deep Blue was more than a match to the then world champion Garry Kasparov.

These stray examples apart, the overall achievements of AI however are not all that significant. This has made some persons to claim that since artificial intelligence hasn't reached human levels even after fifty years of research, it must be impossible. There are also computer scientists who oppose the very idea of AI. Joseph Weizenbaum [2] says that the very idea is obscene, anti-human and immoral.

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The basic problem is the lack of a satisfactory definition for the word intelligence in AI. The scientists would prefer a definition that does not relate to human beings in any way. One definition that comes closest to this requirement is 'Intelligence is the computational part of the ability to achieve goals in the world'. This definition may perhaps satisfy a die-hard computer scientist but not the majority of the public, which includes scientists from several other streams.

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Unfortunately, the computer scientists themselves are not in a position yet to define the intelligence of a computational procedure. A straight answer to a question like 'Is this machine (a program really) intelligent or not?' is not possible at this stage. Hence AI doesn't deal with intelligence per se; instead it studies those problems that the world perceives as related to intelligence in humans or animals. This is similar to a spiritualist's difficulty in defining what God is. Instead he or she discusses what God does. The approaches are remarkably similar.

Similarly it is difficult to measure a program's intelligence or to compare it with other programs and humans through Intelligence Quotient tests. Computers, by their very nature can score over the humans in any IQ test involving speed or memory. Even in rare cases when a human wins over a computer, the reason may be the programmer's deficiency or a poor algorithm. Thanks to parallel computing and advances in hardware, the gap between the human beings and the machines as far as speed and memory are concerned will only increase in days to come. On the other hand, certain abilities possessed by even two year olds are beyond the best computer's reach as on date even with parallel processing.

It is possible for a computer to learn like a child in a limited sense and the concept of Machine Learning has been around since the 1950s. However, AI programs cannot learn like a child from physical experience. Nor do present programs understand natural language well enough to learn much by reading. Oliver G.

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Selfridge says, "Find a bug in a program, and fix it, and the program will work today. Show the program how to find and fix a bug, and the program will work forever" [3]. Computers are yet to learn such simple tricks. Can an AI system improve its intelligence by contemplating about AI like a philosopher? Unfortunately, AI is not at a level at which this process can even begin. In short, a lot remains to be done by AI scientists before one can claim parity between AI and human-level intelligence.

## 3. Neuroscience

Should AI then be written off? Not yet. New fields like Genetic programming, fuzzy logic and artificial neural networks are giving AI a fresh lease of life. Genetic algorithms for example can solve an AI related task by mating random (LISP) programs and selecting the fittest in millions of generations. There are popular courses on the subject [4].

Of the three, neural networks sound more promising for AI since they are directly related to the functioning of the brain. Though since ancient times the Egyptians, Greeks, Indians and several others were aware of the functioning of the brains to varying extents, it was only after the invention of the microscope that a break-through in neurosciences was possible. By late 1890s, scientists were beginning to understand the structure of a neuron, which was identified as the functional unit of the brain. In 1906, Golgi and Ramón y Cajal got the Nobel Prize for Medicines for their characterization of the neurons. Elaborate experiments by several scientists led to the conclusion that certain regions of

the brain were responsible for certain functions like seeing or thinking. The mapping is now almost complete.

The first Society of Neuroscience was founded in 1970. Today, Neurosciences cover several areas including physiology, pharmacology,

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pathology, informatics, genetics and biochemistry. It has intersections with psychology, computer sciences, statistics, physics and medicines. Nobel laureate Eric Kandel contends that cognitive psychology is one of the pillar disciplines for understanding the brain in neuroscience [5]. Even subjects like neuro-economics and social neuroscience are coming up.

While the behaviour of a single neuron is reasonably well-understood, the performance of a network of neurons, considered responsible for human intelligence, is still not well understood.

But research is on. Artificial neural network (ANN) is the mathematical model based on the biological model of the brain and in a way is the intersection of AI and Neurosciences. In ANN, a set of 'artificial' neurons (essentially nodes – also called neurons/neurodes/processing elements/units) are connected together to form a network to process information using a connected approach.

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ANN is an adoptive system that changes its structure based on 'knowledge' gained during the learning phase. It is basically a non-linear, statistical model. Slowly, the biology-based approach is giving way to an approach based on statistics and signal processing but the name sticks.

The attractive feature in neural networks is the possibility of *learning*. There are three major learning paradigms, namely supervised learning, unsupervised learning and reinforcement learning. Supervised learning is similar to learning with a "tutor", the tutor being a suitable feedback system. Unsupervised learning does not use a "tutor" or feedback and is based on an open loop. Reinforcement learning uses the concept of a long-term reward and the objective is to maximize the reward.

ANN is being tried out in a variety of areas including control systems (vehicle control, process control), game-playing and decision making (checkers, chess, racing), pattern recognition (radar systems, face identification, object recognition), sequence recognition (gesture, speech, handwritten text recognition), medical diagnosis, automated share-trading

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systems, data mining, visualization and e-mail spam filtering.

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## 4. The Upanishad's view

To know the spiritualist's point of view on intelligence, one need not go beyond the Upanishads. Great scientists like Schroedinger, Niels Bohr, Oppenheimer and John Wheeler were also Upanishad scholars. Philosophers like Emerson and Schopheneur were its great admirers. Henry David Thoreau, the famous American Naturalist and Philosopher, whom Mahatma Gandhi considered his guru for civil disobedience says "What extracts from the Vedas I have read fall on me like the light of a higher and purer luminary, which describes a loftier course through purer stratum."

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Upanishads are subject to different interpretations and no one can state with finality the Upanishad's view of intelligence or anything else for that matter without inviting a contra-view. There are also the problems posed by the richness of the Sanskrit language. For example, words like *buddhi, vivekam, gnanam, prgyanam, vigyanam* etc. are used to indicate different shades of intelligence in different contexts. The nuances between such words often result in heated arguments among the scholars.

Intelligence is discussed in several places in various Upanishads. For example, Katha Upanishad deals extensively with intelligence. (I.iii.3-13). [6] It starts with an interesting simile between the human body and a chariot. "Know the Self as the master of the chariot and the body, the chariot. Know the intellect as the charioteer, and the mind as verily the bridle." The senses are of course the horses. This is not quite different from a neuro-scientist's point of view. The Upanishad goes on to say that only a sharp intelligence endowed with discrimination can control the 'horses' and the 'chariot' well.

However, the Upanishad diverges at this point itself from the sciences, since it sees a different purpose for intelligence. Thus intelligence is not an end in itself but an instrument for going further up. It declares that only a wise man with a subtle intelligence can hope to understand the Divine. Once the intellect brings the body and the mind under its control, it is able to reach out to the Divinity in itself. The divinity is not seen as a separate entity from the Self. It is another aspect of the Self.

The central philosophy of Upanishads is known as monism (though some scholars may disagree) which talks of the unity of the entire universe and its contents. That single indescribable entity is conveniently given the name Brahman and is always mentioned in the neutral gender. Let it be added here that monism is not unique to Indian thoughts. The Chinese philosophers subscribe to a similar view and call it Tao. So did some of the medieval Western philosophers like the Dutch Spinoza (he called it the Absolute) and later philosophers like Emerson and Schopheneur. Of course they were in a minority and the majority was split between idealism and materialism. Monism incidentally is different from monotheism, which swears by a single supreme God, be it Jehovah, Father, Allah, Siva or Vishnu.

Aitareya Upanishad is more explicit and forthright in this respect and declares that Brahman, the one non-dual reality is revealed as Pure Intelligence –"*Pragyanam Brahma"(*Brahman is intelligence). [7]

While there is no exact English word to describe *Pragyanam*, as mentioned earlier, intelligence is one of the alternatives used by some translators. This is considered as one of the four great sentences (*Mahavakya*) from the Vedas or it the essence of Vedas. Aitereya Upanishad ends up by saying that he who knows that Brahman as existing in the intellect enjoys all desirable things simultaneously.

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Intelligence is also seen as the seat of the Almighty in the human body in the holy *Gayatri Mantra,* which makes an appeal to the Divine to arouse, awaken and strengthen human intelligence - the discriminating faculty of a human being, so that it may lead one through spiritual effort and activities to success.

> The *Gayatri mantra* calls upon the Supreme Intelligence to arouse, awaken and strengthen human intelligence, so that it may lead one through spiritual effort and activities to success.

That God *(tat),* who manifests in the form of light of suns *(savitur)* is worthy of respect *(varenyam).* We meditate *(dheemahi)* upon the light *(bhargo)* of that deity *(devasya).* May He *(yo)* guide in the right direction *(prachodayat)* our *(nah)* intellect *(dhiyo).* [8]. It is interesting to note that the most important prayer of the Upanishads does not ask for mercy or pardon from the Almighty as in some religions, but asks only for a clear intellect so that Truth may be reflected therein without distortion.

Is intelligence the only attribute of the Ultimate? Obviously not. There are other attributes like truth, existence, infinite and bliss. Thaithriya Upanishad for example declares *Satyam gnanam anantham Brhama.* "Brahman is Truth, Knowledge and Infinite. [9] In several places, Brahman is described as *Sat chit anandam* - existence, mind /intelligence and bliss.

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The examples are endless and so are the interpretations. However, if one can summarise the Upanishad's view of intelligence at this stage, then the exalted position given to intelligence becomes obvious. Intelligence is not merely the controller of the physical body and the subjugator of the senses, it is the key instrument for

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realizing the Ultimate. In fact it is the seat of Ultimate and also a major attribute of the Ultimate. No praise higher than this is possible.

**5. Conclusion**

Based on the above discussions which are necessarily brief, one can see the contrast between the scientific view and the spiritual view on intelligence. Due to its obsessions with precise definitions and objective methodologies, science is still close to the starting point while dealing with intelligence and has not progressed much. Spirituality or Upanishadic wisdom to be precise, without such inhibitions, and based only on the intuition of the seers, seems sure of what it is talking about, makes declarative statements and presents a grand vision of intelligence and its association with the Absolute.

It will not be in the nature of science to adopt intuition as a tool or to make sweeping conclusions or grand statements. But one funny thought crosses the mind. It is taken from an anecdote of Birbal, the legendary minister of Emperor Akbar. Akbar once asked Birbal to find out the ten worst idiots in his capital. One prize catch was a fellow who was searching for his lost ring under a streetlight during the night. When questioned by Birbal, the poor fellow accepted that the ring was actually lost elsewhere but he was searching in this particular spot because it had light. Does science know where the ring of intelligence really lie? A mere thought.

Science and spirituality can really complement each other like hardware and software or knowledge and experience in understanding a complex a concept like intelligence. In turn the study of intelligence can be an interesting journey in which one starts with the rigours of science and ends up with the beauty of spirituality. It is obvious that *One Thing exists and connects the Many things*. Chinese may call it as Tao, Indians may call it as Brahman and Spinoza may call it as Absolute but the names do not matter at the end of the day. The ancient seers understood the universe as a unity and the present generation is only struggling to re-discover the same.

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