

AI and Vivekananda

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Whatever you think, that you will be. If you think yourselves weak, weak you will be; if you think yourselves strong, strong you will be
— *Swami Vivekananda*

Abstract

Arguably the most important information process to understand is human intelligence itself. Vivekananda directly addressed this question together with the function of the mind, its relationship to the senses and its training or education. von Neumann provided the first serious examination of our thinking and the computing machine. He also formulated the fundamental architecture of the computer. Artificial Intelligence (a.k.a machine learning) and its relationship to human knowledge and intelligence have long been the study of scientists such as Bellman, Feynman, Shannon, Simon, Turing and von Neumann himself. Philosophers Lao Tze and Zhuangzi, Seneca and Epictetus and Ramakrishna, Ramana Maharishi and Yogananda have long addressed issues of the mind, thought and body. Thomas Bayes and David Hume discuss probabilistic learning and inductive inference. Milton Erickson and Steve Andreas provide implementation of psychological processes to change neural connections between thoughts and emotions. Vivekananda, a personal friend of Tesla, foresaw the merging of philosophical and scientific ideas. Our goal is to merge these ideas through the lens of artificial intelligence, machine learning algorithms and computational storage and power.

Key Words: AI, Bayes, Feynman, Hume, Shannon, von Neumann, Machine Learning, Quantum Computation, Vivekananda.

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1 Introduction

The Science of the Mind, Thought and Function has long interested philosophers and scientists alike. Vivekananda and Vedanta philosophy has roots in wave and magnetism theories of Maxwell and Tesla. Vivekananda and Tesla were good friends. Tesla (1907, *Man's Greatest Achievement*) describes the Vedantic concepts of *Akasha*—the ether from which the other elements emerge—and *Prana*—the vital force of life—as follows:

Long ago... (mankind) recognized that all perceptible matter comes from a primary substance, or tenuity beyond conception, filling all space, the *Akasha* or luminiferous ether, which is acted upon by the life giving *Prana* or creative force, calling into existence, in never ending cycles all things and phenomena. The primary substance, thrown into infinitesimal whirls of prodigious velocity, becomes gross matter; the force subsiding, the motion ceases and matter disappears, reverting to the primary substance.

—Nikola Tesla

Whilst aether theories are controversial, Vivekananda wrote extensively on the theory of the mind, thought and emotion. In particular, he defines the function of the mind as having four components (*chitta, manas, buddhi, ahamhara*) which roughly translated correspond to: Memory, Deliberation and Conceptualization, Determination and Decision-making, 'I' Consciousness, respectively.

Scientific thought (a.k.a. the philosophy of science) has a long history. The scientific method (Fisher, Jeffreys) was developed with a view to construct empirical methods to reveal the true *state of nature*. Induction reasoning (Hume, Bayes, Laplace, Poincaré) used the laws of probability to provide logical systems of learning with a goal of finding the truth. Formalising learning, in such a fashion, leads to Bayes rule for coherently updating prior to posterior probabilities (Bayes, de Finetti)—a form of disciplined probability accounting. The notion of *inverse probability* and calculating the probability of a cause given an effect, denoted by $p(\text{cause}|\text{effect})$, was originally applied to epistemology questions of religious belief.

Vivekananda had interesting views on whether one should try and find *causation*. In: *The Complete Works* (ch. 7 *On Freedom*) Vivekananda expresses the link between Karma, Causation and Inductive Inference as follows:

In addition to meaning work, we have stated that psychologically the word Karma also implies causation. Any work, any action, any thought that produces an effect is called a Karma. Thus the law of Karma means the law of causation, of inevitable cause and sequence. Wheresoever there is a cause, there an effect must be produced; this necessity cannot be resisted, and this law of Karma, according to our philosophy, is true throughout the whole universe. Whatever we see, or feel, or do, whatever action there is anywhere in the universe, while being the effect of past work on the one hand, becomes, on the other, a cause in its turn, and produces its own effect. It is necessary, together with this, to consider what is meant by the word "law". By law is meant the tendency of a series to repeat itself. When we see one event followed by another, or sometimes happening simultaneously with another, we expect this sequence or co-existence to recur.

—Swami Vivekananda

Hume had similar ideas, he argues that we cannot conceive of any other connection between cause and effect, because there simply is no other impression to which our idea may be traced. This certitude is all that remains. For Hume, the necessary connection invoked by causation is nothing more than this certainty. Ramsey links *Truth and Probability*.

The notion of a *truth seeker* dates at least to Milton in *Areopagitica*

TRUTH indeed came once into the world with her divine master, and was a perfect shape most glorious to look on: but when he ascended, and his apostles after him were laid asleep, then straight arose a wicked race of deceivers, who, as that story goes of the Egyptian Typhon with his conspirators, how they dealt with the good Osiris, took the virgin Truth, hewed her lovely form into a thousand pieces, and scattered them to the four winds. From that time ever since, the sad friends of Truth, such as durst appear, imitating the careful search that Isis made for the mangled body of Osiris, went up and down gathering up limb by limb still as they could find them. We have not yet found them all, lords and commons, nor ever shall do, till her Master's second coming; he shall bring together every joint and member, and shall mould them into an immortal feature of loveliness and perfection. Suffer not these licensing prohibitions to stand at every place of opportunity forbidding and disturbing them that continue seeking, that continue to do our obsequies to the torn body of our martyred saint.

— John Milton

Brodsky provides a cold-hearted view of life

Life is a game with many rules but no referee. One learns how to play it more by watching it than by consulting any book, including the holy book. Small wonder, then, that so many play dirty, that so few win, that so many lose.

—Joseph Brodsky

In order to comprehend *Truth*, we also have to ask *Who Am I?*

The Atman: Witness Consciousness The question of who you are is known as the practice of *Witness Consciousness*. Ramana Maharishi's famous book *Who am I?* defines *You*: You are not the body, or your's minds or thoughts, you are that which observes, called the *Atman*. You can't be anything that you imagine or describe. The Yogi view is that the Atman (a.k.a soul) is constant through life. This constant holds for all things, as Vivekananda observes

Out with the differentiation between man and woman—all is Atman!

—Swami Vivekananda—*Letters*

Mediation is simply a way of getting rid of noise—data collected by the senses—and realising that you're the Atman.

Think of the mind as a lake, where good and bad tendencies or thoughts surface. This time is precisely when you can change their nature, before they sink back into the depths of the lake. Water plays a central role in understanding this approach

Be like water making its way through cracks. Do not be assertive, but adjust to the object, and you shall find a way around or through it. If nothing within you stays rigid, outward things will disclose themselves. Empty your mind, be formless, shapeless, like water.

You must be shapeless, formless, like water. When you pour water in a cup, it becomes the cup. When you pour water in a bottle, it becomes the bottle. When you pour water in a teapot, it becomes the teapot. Water can drip and it can crash. Become like water my friend.

—Bruce Lee

The Chinese philosopher Lao Tze describes *water* and its Atman-like qualities via mantras

Water is fluid, soft and yielding. But water will weak away rock, which is rigid and cannot yield. As a rule, whatever is fluid, soft and yielding will overcome whatever is rigid and hard. This is another paradox: what is soft is strong

—*Lao Tze*

The Present Moment A key concept is living in the present moment

There is no past or future, only present

— *Ramana Maharishi*

Meditation, Attachment and Detachment are ways to achieve such a goal.

Attachment Vivekananda's thoughts on attachment are described clearly by

Be "unattached"; let things work; let brain centers work; work incessantly, but let not a ripple conquer the mind. Work as if you were a stranger in this land, a sojourner; work incessantly, but do not bind yourselves; bondage is terrible.

— *Swami Vivekananda*

Lao Tze describes the equivalent of Attachment and Detachment via Yin and Yang:

All things carry Yin, yet embrace Yang. They blend their life breathes in order to produce harmony

—*Lao Tze, Tao Te Ching*

Much of the secret of Meditation comes in the uncoupling of mind and senses—viewing the world from one of attachment versus detachment and being able to switch between these states seamlessly.

We now provide a formal definition of Yoga.

Yoga Yoga is concerned with the process of self-realisation—Witness Consciousness.

Put simply, Yoga is a way of understanding the forms of triples (*thoughts, emotions, actions*) and the corresponding map to (*storage, memory, retrieval*) of the mind. Yoga can be viewed as a data collection mechanism, thus providing the link with machine intelligence. Learning should be simply viewed as an efficient data storage/memory mechanism.

There are three types of Yoga: *Jnana, Bhakti, Karma* corresponding to the path of knowledge, path of loving and devotion, path of action, respectively. *Bhakti Yoga* and *Karma Yoga* have yielded systems and techniques to gain self-realisation. All pertain to the training of the mind and the manifestation of thoughts and actions into the ether. Yogananda, a proponent of *Kriya Yoga*, discusses the application of *Pranayama* and the effect on a person's *Prana*—life force. This involves breathing techniques, mantras and meditation.

Different forms of Yoga are concerned with the two way interaction between the thoughts of the mind and the observational senses. Tesla, Vivekananda and Poincaré observational view of (*mind, body, senses*) as similar to theories of special and general relativity—our view is the link with artificial intelligence.

Ramakrishna used healing techniques based on Bhakti yoga and mantras. Mantras can be viewed as "basis functions", sayings as to which the mind must train itself on. Some logically consistent, others not.

The Chakras Knowledge originates in two ways—direct perception from the senses and the external world, the other begin memory. This is the result of *samskaras* or latent impressions of past experience lying buried in the mind. A *Vasana* is a human tendency or karmic imprint which influences the present human action of a person. A person can exhibit many *asanas* which some think existed in past lifetimes. Latent impressions in the mind, when activated, can recreate the original experience. Many thoughts originate in memories and Meditation and Hypnosis are techniques for controlling memory.

In Vivekananda's lectures on "*Raja Yoga*" he describes the seven *Chakras* in the body which are: Muladhara, Swadhisthana, Manipura, Anahata, Vishuddha, Ajna and the highest Chakra is called the Sahsrara Chakra. Our goal is to exist in a higher Chakra state (Jnana Yogi) rather than to live in the lower Chakras.

The Mind and Mantras

If you want to go East don't go West

— *Ramakrishna*

Mantras were particularly helpful to Vivekananda—a Jnana Yogi—to clear his mind from analytical thoughts.

Some of the views of Vedanta can be found in the works of the Stoics, Lao Tze, Zhuangzi, Milton Erickson and Steve Andreas.

Stoics There are a multitude of Greek philosophers with similar Vedic ideas with too many to address here. Two that seem most related are. Seneca and Epictetus. Seneca wrote *On Happiness* and *On Anger* among others. Epictetus wrote extensively and viewed only the educated as being free and had a reactionary view on thoughts and actions; for example,

It is not what happens to you, but how you react to it that matters

—*Epictetus*

Lao Tze Lao Tze was well aware of mediation techniques and the relationship with the ether. The *Tao Te Ching* by Lao Tze describes Taoism, a way of life. the two main concepts are Ch'i and Te: **Ch'i**: Literally translated by: "air, vapors, ether, breathing, energy". At the same time it means "temperament, power, atmosphere". Ch'i is one's vital life force but also the universal spiritual energy pervading all beings. **Te**: Literally translated as "virtue, power". The specific qualities that Tao gives to everything. The power gained by attaining Tao.

Zhuangzi is of particular interest when discussing the theory of the mind and consciousness.

Zhuangzi The Daoist philosopher Zhuangzi who authored *The way of Chang Tzu* during the late Warring States period (476–221 BCE) wrote a famous short story that tells of Zhuang Zhou who once dreamed he was a butterfly, flitting and fluttering around, happy, and doing as he pleased. As a butterfly, he did not know he was Zhuang Zhou.

A famous quote of Zhuangzi on happiness is the following:

"A path is made by walking on it." "Rewards and punishment is the lowest form of education." "The wise man knows that it is better to sit on the banks of a remote mountain stream than to be emperor of the whole world." "Happiness is the absence of the striving for happiness.

— *Zhuangzi*

Milton Erickson

Allow yourself to see what you don't allow yourself to see

—*Milton Erickson*

Possibly the greatest modern-day exponent of mind and thought interaction is best seen in the works of Milton Erickson. Erickson would only see patients once for a short period. He invented many techniques for diagnosing and correcting fears and anxieties. Erickson also practiced hypnosis in extreme cases. There are well documented case studies showing success and failures in his approach. Again getting the subject to do things and associate/order things in the mind differently is of paramount importance. If one wishes to lose weight, he would advise eating whatever and whenever you please, leading to a dramatic *increase* in weight—only for the mind to be so sick of such a state that it convinces itself to slim.

Steve Andreas The field of Neuro-Linguistic Programming (NLP) provides many interesting examples of curing human phobias and tendencies getting reversed. Association techniques relating images with good and bad states of a person's thoughts can clear blockages in human thinking and action. Much like practicing the the art of mind lake observation by the Atman proposed by the Yogis, the application of NLP seeks to relieve certain tensions in the mind.

Rather interestingly before doing anything, Andreas would ask the subject if they want to be put in the change of state. By attaching shape, form and color to any emotion (e.g. fear/anger) he would reverse the emotion by switching the spin or color of the to the subject's favorite color Using a glass barrier to separate mind from event was a helpful approach. Once their perception was changed, Andreas would then run this process through a time line of the subjects suffering thus clearing all the pathways that existed in the mind concerning that emotion.

David Hume Hume was greatly influenced by the scientific revolution, particularly by works of Sir Isaac Newton. He was an Empiricist,

Causes and effects are discoverable not by reason, but by experience

—*David Hume*

He goes on to say that, even with the perspective of the past, humanity cannot dictate future events because thoughts of the past are limited, compared to the possibilities for the future.

As a parallel to Vivekananda's description of the human mind, machine intelligence addresses issues of knowledge, information retrieval and actions.

Richard Feynman Feynman was also an Empiricist: [Can we learn the rules of Chess?](#)

Let's say a chess game. And you don't know the rules of the game, but you're allowed to look at the board from time to time, in a little corner, perhaps. And from these observations, you try to figure out what the rules are of the game, what [are] the rules of the pieces moving.

You might discover after a bit, for example, that when there's only one bishop around on the board, that the bishop maintains its color. Later on you might discover the law for the bishop is that it moves on a diagonal, which would explain the law that you understood before, that it maintains its color. And that would be analogous we discover one law and later find a deeper understanding of it.

Ah, then things can happen—everything's going good, you've got all the laws, it looks very good—and then all of a sudden some strange phenomenon occurs in some corner, so you begin to investigate that, to look for it. It's castling—something you didn't expect

After you've noticed that the bishops maintain their color and that they go along on the diagonals and so on, for such a long time, and everybody knows that that's true; then you suddenly discover one day in some chess game that the bishop doesn't maintain its color, it changes its color. Only later do you discover the new possibility that the bishop is captured and that a pawn went all the way down to the queen's end to produce a new bishop. That could happen, but you didn't know it.

— Richard Feynman

Artificial Intelligence Artificial intelligence (a.k.a. machine learning) is an Empiricist. Can we simply (*store, memorize, retrieve*) knowledge and information at will to satisfy our desires and make optimal actions?

Experience is the only teacher we have. We may talk and reason all our lives, but we shall not understand a word of truth, until we experience it ourselves—

—Swami Vivekananda

Meditation and mantras, from the perspective of artificial intelligence, are simply re-training neural connections via association techniques are precisely the same as the "neural network" of connections in the mind getting re-booted. This duality is exploited when we construct our theory linking the interplay between artificial intelligence and Vivekananda's philosophy.

Our Five Senses, from an artificial intelligence perspective, are nothing more than "observations" on the dynamic evolution of the ether and the goal is to merge information from these different sources. One thing that has become apparent, a great virtue of Bayesian updating, updating and modern pattern matching algorithms such as deep learning is that they are good at these tasks with high throughput of information.

Bellman wrote the book *Artificial Intelligence: Can Computers Think?* von Neumann gave a series of lectures on *The Computer and the Brain*. Feynman provided many interesting discussions of how machines "think" versus human thinking and he describes the problem of *Artificial General Intelligence* by describing whether a machine can learn the rules of chess from purely empirical observation. Herb Simon, an early pioneer of machine learning and computing techniques, describes how humans have intuition and solve complex decision problems. This is intimately related to how Vivekananda saw education of the human mind and his thoughts on knowledge and information.

We proceed as follows. Section 2 describes Vivekananda's philosophy of mind, thought and emotion with emphasis on personality development. Section 3 provides a parallel framework for Artificial Intelligence and Machine Learning using the connection between Mind, Thoughts and Actions described above. Put simply, one can view machine learning algorithms as placing mathematical structures and algorithmic instructions to simulate the mind. Here we draw on the work of Bellman, Feynman, Shannon, Simon, Turing and von Neumann. Section 4 concludes with how Vivekananda saw education and implications for human development.

2 Vivekananda: Theory of the Mind

The highest type of civilization is found in him who has learned to conquer self
— Swami Vivekananda

What was the central message of Swami Vivekananda? Vivekananda was never tired of rousing people to be conscious of their inherent divinity and perfection. He wanted this divinity to manifest in our day-to-day lives. In fact, he held this manifestation of divinity as the sole index of civilization of humankind: *The Complete Works of Swami Vivekananda*. One of his famous quotes in this regard is

A nation may conquer the waves, control the elements, develop the utilitarian problems of life seemingly to the utmost limits, and yet not realize that in the individual, the highest type of civilization is found in him who has learned to conquer self
—Swami Vivekananda

Vivekananda defines the fourfold function of the mind. The following from his book *Personality Development* summarises his thought.

2.1 The Fourfold Functions of the Mind:

The human mind has four basic functions according to Vivekananda. This can be illustrated by an example: suppose I meet a person whom I had met somewhere, say, about ten years before. I try to recollect when and where I met him and who is he. From the inner recesses of my mind there begins a process of scanning, as it were, to check if there are any events stored there connected with the person. Suddenly I am able to recognize the person as so and so and finally say "he is the same person I met in such and such a place", etc. I now have a firm knowledge about the person. This process can be formalised in terms of four functions:

1. Memory *chitta*: The storehouse of memory and impressions of our past experience presents various possibilities before the mind. This storehouse is called *chitta*. It is in this storehouse that the impressions of our thoughts and actions—good and bad—are stored. The sum total of these impressions determine our character. This *chitta*, again is what is known as our subconscious mind.

2. Deliberation and Conceptualization *manas*: Not yet sure, the mind examines the many options presented before it. It deliberates on several things. This faculty of the mind is called *manas*. Imagination and formation of concepts are also functions of the *manas*.

3. Determination and Decision-making *buddhi*: is the faculty responsible for decision making. It has the capacity to judge the pros and cons of things and find what is more desirable. It is also the discriminative faculty in a person, which enables him to discriminate between the real and the unreal, between what is to be done and what is to be avoided, what is morally right and what is wrong. It is also the seat of will-power so essential for personality development and hence this aspect of the mind concerns us the most.

4. 'I' Consciousness *ahamkara*: Appropriating to oneself all physical and mental activities eg, 'I eat', 'I see', 'I talk', 'I hear', 'I think', 'I am confused', etc., is called *ahamkara* or 'I' consciousness. As long as the 'I' identifies itself with the undisciplined body-mind complex, human life is dictated by events and circumstances of the world; we become happy with pleasurable events, and miserable with adverse circumstances. More the mind gets refined and disciplined, more does one get to know the real source of 'I' consciousness. Correspondingly, a person becomes more balanced and equipoised in his daily life. Such a person is no longer swayed by any event or circumstances of life.

2.2 Personality Development

Personality development involves the struggle with one's lower mind characterized by desires, old habits, wrong tendencies, impulses and bad impressions. The lesser we identify with the lower mind, and the more we identify with the higher mind, and exercise our *buddhi* (discrimination), the more developed will our personality be. This involves struggle grapple with one's mind and its old habits, to cultivate new and wholesome ones this struggle is the greatest of all struggle that it makes us civilized in the real sense of the term by manifesting our thereby our hidden perfection.

Vivekananda outlines the essential qualities for personality development as follows:

Necessity to know our mind: We intend to do many things—make resolutions to cultivate good habits, to kick certain bad habits, to study with concentration, to do something with a concentrated mind. Very often our mind rebels, forcing us to beat a retreat from our efforts at implementing our resolutions. A book is open before us, and our eyes are open. But the mind has started wandering, thinking about some past events or some future plans.

Have Faith in Oneself: Vivekananda held faith in one's potential divinity as the sheet anchor of personality development. Faith in God came next only to faith in oneself. If one believes that one's real nature is the spirit – not the body or the mind—one would be a better individual with strong character.

Think Positive Thoughts: Vivekananda decried, in no uncertain terms, weakness in human beings. Positive, wholesome thoughts based on our inherent divinity are essential for a strong character. 'Go on doing good, thinking holy thoughts continuously, that is the only way to suppress base impressions... Character is repeated habits and repeated habits alone can reform character.' Further, according to Vivekananda, the only sin is to think of oneself and others as weak.

Attitude towards Failures and Mistakes: Vivekananda advocated upholding the ideal once again even if a person failed. So never mind these failures, these little backslidings; hold the ideal a

thousand times, and if you fail a thousand times, make the attempt once more. Take courage and work on. Patience and steady work—this is the only way.

According to the *Bhagavad Gita*, the undisciplined mind acts as our enemy, whereas a trained mind acts as our friend. So we need to have a clear idea of the mechanism of our mind. Can we train it to obey us, to cooperate with us? How can it contribute to the development of our personality?

Charity and Giving: Vivekananda's view was that the best form of charity or giving is one's own self-realisation and to *Believe in Yourself!*

Helping others physically, by removing their physical needs, is indeed great, but the help is great according as the need is greater and according as the help is far reaching. If a man's wants can be removed for an hour, it is helping him indeed; if his wants can be removed for a year, it will be more help to him; but if his wants can be removed for ever, it is surely the greatest help that can be given him.

— Swami Vivekananda

What is Character? Every action and thought of ours leaves an impression in our mind. These impressions determine how we behave at a given moment, how we respond to a given situation. The sum total of all our impressions is what determines our character. The past has determined the present. Even so the present our present thoughts and actions—will shape our future. This is a key principle governing personality development. What activates the body-mind system?

This is an important question, the answer to which will help us have better knowledge of ourselves. This question engaged the attention of ancient Indian *seers* and *sages*. They experimented with themselves—their sensory and mental apparatus—and after a disciplined quest they found out that there is a divine element in human beings, which is the Mind of mind, Eye of the eyes, Ear of the ears, a Speech of the speech. It is this divinity which constitutes the real 'I' and the eternal element in our personality. This divinity survives physical dissolution of the body. This divinity remains latent in us as long as we identify ourselves with our body-mind and the sensory system. The goal of life, according to the scriptures and the great ones, is to manifest this hidden divinity.

One of Vivekananda's key ideas is Attachment and being able to Detach from one's Thoughts and Emotions at will.

Karma Yoga: Meaning of Work

Do you not see how everybody works? Nobody can be altogether at rest; ninety-nine per cent of mankind work like slaves, and the result is misery; it is all selfish work. Work through freedom! Work through love! The word "love" is very difficult to understand; love never comes until there is freedom...

— Swami Vivekananda

The nature of work and *why work* has long been the subject of philosophical thought. In the essay *In Praise of Idleness*, the famous philosopher Bertrand Russell provided the following categorisation of types of work

Work is of two kinds: first, altering the position of matter at or near the earth's surface relatively to other such matter; second, telling other people to do so.

The first kind is unpleasant and ill paid; the second is pleasant and highly paid. The second kind is capable of indefinite extension: there are not only those who give orders, but those who give advice as to what orders should be given.

Usually two opposite kinds of advice are given simultaneously by two organized bodies of men; this is called politics. The skill required for this kind of work is not knowledge of the subjects as to which advice is given, but knowledge of the art of persuasive speaking and writing, i.e., of advertising.

—*Bertrand Russell*

Joseph Brodsky, in a famous Soviet court case, rebelling against a law of having to work had this interchange on education and work with the judge

Judge: And who recognized you to be a poet? And who put you in the ranks of poet?

Brodsky: No one. And who put me in the ranks of humanity?

Judge: Did you study it? ... How to be a poet? Did you attempt to finish an institute of higher learning ... where they prepare ... teach

Brodsky: I did not think that it is given to one by education

Judge: By what then?

Brodsky: I think that it is from God.

—*Joseph Brodsky*

Kriya Yoga: Self-Realisation Yogananda in *Autobiography of A Yogi* describes Kriya.

Kriya Yoga is Mathematics

— *Paramahansa Yogananda*

2.3 The Mind, Mantras, Meditation and Senses

Thoughts, Emotions and Actions They provide the basic flow of life. A running definition of Emotions is given by

Emotions are thoughts but with fire (desire) attached to them. They will lead to action.

—*Shiva*

Ramana Maharishi One guru who dealt in thoughts and emotions was Ramana Maharishi. His approach was one of *silence*. Silence being the answer to all questions

The degree of freedom from unwanted thoughts and the degree of concentration on a single thought are the measure to gauge spiritual progress

—*Ramana Maharishi*

This also lead him to a simple definition of meditation.

When there are thoughts it is distraction, when there are no thoughts it is meditation

—*Ramana Maharishi*

Ramakrishna His approach was based more on Bhakti yoga, rituals and mantras.

Short Stories as Mantras Chinese philosophers wrote many short stories for the mind to ponder and “re-train” neural connections. *A visit on a Snowy Night* provides a stark example of how thoughts, emotion and action evolve.

Wang Ziyou (? – ca386) lived in Shan Yin. One night while it was snowing heavily, he got up from his bed, opened the door, and told his servant to bring some wine. Looking outside, he found that everything within sight was covered by a shimmering layer of snow. Feeling a little restless, he paced up and down his room, reciting the “Ode to the Recluse” by Zuo Si. Suddenly, his friend Dai Andao, who lived in Shan, came to his mind. He decided to pay him a visit by boat that very night. On reaching Dai’s doorsteps, he ordered the boatman to return home, without disembarking to see his friend. Somebody, puzzled by this act, asked Wang Ziyou the reason for his behavior. He replied, “I set out in high spirits, and returned after a thoroughly enjoyable trip. Why bother to go in to see Dai?”

—Ruan Ji

Causation seems of little interest in these situations. There is no need, or advantage, to ask *Why?*

As Tesla and Vivekananda summarize the evolution is simply Karmic, providing equal and opposite reactions in the ether. Thoughts can go a long way and exist in space and time.

Senses Sight, Sound, Smell, Taste and Touch. An extract from *Personality Development* summarises clearly the challenge of linking the mind and senses.

The *Katha Upanishad* describes human personality with the help of a chariot allegory. ‘Our ‘I’ is represented by the master of the chariot; the body is the chariot and the *buddhi* the charioteer. The manas is represented by the reins to which are yoked the horses representing the sense organs—ears, skin, eyes, tongue and nose—which are the five windows in a human being that give him or her the knowledge of objects in the world. The road on which the chariot travels is represented by the sense objects. The human being who identifies himself or herself with this body-mind system is said to be the enjoyer of objects or the fruits of actions. If the horses are not broken and if the charioteer is asleep, the chariot cannot reach its destination. It can even overturn and spell the death of the master. Similarly, if the sense organs are not disciplined, and if the power of discrimination lies dormant, one cannot reach the goal of human life.

On the other hand, if the horses are broken and the charioteer is wide-awake, the chariot reaches its destination. Even so, if the *buddhi* is wide awake, and if the sensory system together with the mind is disciplined and controlled, a human being can reach the goal of his life. What is that goal? We will come to it shortly. Another important activity of the mind that concerns personality development is our emotions. More the emotions are under control, healthier becomes one’s personality. Emotions can be broadly classified into two types, viz attraction and repulsion. Love, admiration, aspiration, sympathy, joy, veneration, pride and the like indicate attraction. Hate, anger, fear, sorrow, jealousy, disgust, shame, etc., are of the nature of repulsion. As long as one is entangled with the undisciplined mind one’s personality does not really develop, *buddhi*, the charioteer,

serves as an effective instrument of self-development by controlling the emotions and raising the higher self from the hold of the lower mind.

—*Personality Development, Swami Vivekananda*

The use of short stories have also been used to “re-boot” the mind are commonplace.

The senses (*indriya*) were discussed at length by Vivekananda

Back from the senses, back! Do not go to the senses is the watchword of Vairagya (Detachment)

—*Swami Vivekananda*

and on assessing emotions (thoughts with desires (a.k.a. utilities))

Emotions have more connection with the senses than with the faculty of reason

Happiness and misery are only in the senses, they cannot touch our real Self

—*Swami Vivekananda*

Brodsky, among many other, expressed his views on these connections

What concerns me is the man, unable to articulate, to express himself adequately, reverts to action. Since the vocabulary of action is limited, as it were, to his body, he is bound to act violently, extending his vocabulary with a weapon where there should have been an adjective

—*Joseph Brodsky*

The external nature of the senses is given by his quote

The eye identifies itself not with the body it belongs to but the object of its attention

—*Joseph Brodsky*

The senses then are a five dimensional observational system. A set of basic “skills” so to speak. There’s noise, however, and hence confusion can arise. Mediation lets you “turn-off” the senses and re-learn the basics.. Combining data from different sources (e.g. sight and speech) is a function of the mind. By combining simple tasks, you can “solve” bigger ones. This is an interpolation/prediction step as tomorrow’s data is just a prediction from yesterday.

One should activate system that is already within as Vivekananda would say.

2.4 Economics, Markets, Political and Economy

Theory of Rational Choice There is a parallel with the mathematics of choice. Thoughts can be viewed of as *probabilities*—based building blocks obtained via assessment of simple lotteries. Ramsey provides an axiomatic framework for *Truth and Probability* based on the existence of a *fair bet*. Similar to the use of silence as the benchmark for interpreting speech and data. Then thoughts being preferences for compound lotteries, and desire being utilities. Then actions come from maximising expected utility. von Neumann and Morgenstern and Savage provide an axiomatic formulation of expected utility. de Finetti famously announced that “*Probability Does Not Exist*” in his framework for subjective probabilities being solely based on the *Principle of Coherence*.

Conditional probability and Bayes rule can be deduced from the principle of coherence and are not axiomatic in anyway. They are probabilistic counting mechanisms.

Markets The relationship with Economic, Markets and Political Economy has long interested researchers. Keynes' famous essay on *Economic Consequence for our Grandchildren* provides many insights as to how the slow accumulation of wealth can lead to freedom and leisure.

The Ether and the Market The market is the collective knowledge of all the participants. Tesla and Vivekananda's view of the Akasha, implies that thoughts can effect the external world via market forces. Thoughts can exist in the ether for long periods of time and this collective nature has lead to the madness of crowds for market participants.

Let the market forces decide

—Adam Smith

Trading and Markets Vivekananda describes clearly the nature of human action with regard to trading and the markets

Whatever we do, we want a return. We are all traders. We are traders in life, we are traders in virtue, we are traders in religion. And alas! we are also traders in love.

If you come to trade, if it is a question of give-and-take, if it is a question of buy-and-sell, abide by the laws of buying and selling. There is a bad time and there is a good time; there is a rise and a fall in prices: always expect the blow to come. It is like looking at the mirror. Your face is reflected: you make a grimace—there is one in the mirror; if you laugh, the mirror laughs. This is buying and selling, giving and taking.

We get caught. How? Not by what we give, but by what we expect. We get misery in return for our love; not from the fact that we love, but from the fact that we want love in return. There is no misery where there is no want. Desire, want, is the father of all misery. Desires are bound by the laws of success and failure. Desires must bring misery. The great secret of true success, of true happiness, then, is this: the man who asks for no return, the perfectly unselfish man, is the most successful. It seems to be a paradox

— Swami Vivekananda

This was re-expressed in *Atlas Shrugged* (p. 1220) by John Galt as *The Trader Principle*

The symbol of all relationships among [rational] men, the moral symbol of respect for human beings, is the trader. We, who live by values, not by loot, are traders, both in matter and in spirit. A trader is a man who earns what he gets and does not give or take the undeserved. A trader does not ask to be paid for his failures, nor does he ask to be loved for his flaws. A trader does not squander his body as fodder or his soul as alms. Just as he does not give his work except in trade for material values, so he does not give the values of his spirit—his love, his friendship, his esteem—except in payment and in trade for human virtues, in payment for his own selfish pleasure, which he receives from men he can respect. The mystic parasites who have, throughout the ages, reviled the traders and held them in contempt, while honoring the beggars and the looters, have known the secret motive of their sneers: a trader is the entity they dread—a man of justice.

— John Galt

From a practical viewpoint, trading provides many life lessons

The speculator's chief enemies are always boring from within. It is inseparable from human nature to hope and to fear. In speculation when the market goes against you hope that every day will be the last day and you lose more than you should had you not listened to hope to the same ally that is so potent a success-bringer to empire builders and pioneers, big and little. And when the market goes your way you become fearful that the next day will take away your profit, and you get out too soon. Fear keeps you from making as much money as you ought to. The successful trader has to fight these two deep-seated instincts. He has to reverse what you might call his natural impulses. Instead of hoping he must fear; instead of fearing he must hope. He must fear that his loss may develop into a much bigger loss, and hope that his profit may become a big profit

—Jesse Livermore

All a person needs to do is observe what the market is telling him and evaluate it

—Jesse Livermore

The Austrian School of Economics has similar views on money, credit and medium of exchange—Ludwig von Mises *Human Action*), Schumpeter's theory of creative destruction and Veblen's theory of conspicuous consumption describe the evolution of market dynamics in extreme situations together with its relationship with social status and power.

3 Artificial Intelligence

Can we live by empirical observation alone?

Artificial Intelligence (a.k.a. machine intelligence) is an Empiricist. A running definition of intelligence (human or machine) is given by

Can knowledge and information exist as a triple (*store, memorize, retrieve*) and be instantaneously recalled at will to satisfy our desires via our actions?

—Intelligence

von Neumann was well aware for the need of instantaneous recall when constructing the link between storage. This provides a link with *Education*—the training of the mind with a primary goal of sharpening focus and concentration—the outcome being instantaneous recall of information and action.

An Algorithm is simply a set of instructions.

Piecing together algorithms gives the 'appearance' of Intelligence. There's a question of how they 'know' what instructions to follow.

Spoken language, walking, understanding a number system, vision are all input-output maps. If we string them together we have an "algorithm". The human can "communicate and seem "smart" by describing a painting with many details. The key idea is to "train" your thoughts on the basic inputs (e.g. checkmate patterns, or tactics puzzles)

The central question for an algorithm is speed of computability. Turing famously wrote about computability of functions (a.k.a predictive rules). Intelligence is then created by piecing together algorithms giving the "perception" of intelligence.

The map is a look-up table and learning a refinement via Bayes rule simply updates the table.

Knowledge and Information

Without Knowledge, skill cannot be focussed. Without skill, strength cannot be brought to bear; and without strength, knowledge may not be applied

— *Alexander the Great*

The triple (*Storage, Retrieval, Calculation*) are key data and algorithmic properties.

Yoga and Machine Intelligence Many thoughts originate in memories and meditation and hypnosis are techniques for controlling memory. The practice of Yoga is then the execution of a mapping within the mind of triples

$$(thoughts, emotions, actions) \rightarrow (storage, memory, retrieval)$$

Yoga is an algorithmic data processing mechanism.

Unsupervised Learning is an algorithm that learns patterns from untagged data. Through mimicry of the input space the algorithm can generate imaginative inputs

Supervised Learning is a task of learning a function that maps an input to an output based on example input-output pairs. It infers a function from labeled training data consisting of a set of training examples.

Memory: —2vec The input x can be a (*vector, matrix, tensor*). For example, words, images and videos. Speed of data manipulation is governed by computer chips (CPU, GPU, TPU) and mathematical libraries (MKL, CUDA) not computer coding language, per se.

It has finally been recognized that running a library, or any system requiring the extensive storage and retrieval of facts and ideas; is a complex mathematical process. In the same fashion we must acknowledge the intricate mathematical structure of the educational process.

—*Richard Bellman*

3.1 The Fourfold Functions of the Mind of a Machine

The task at hand is to find an input-output map. To do this, we collect a training sample (input and output pairs). A map is trained and then interpolated to find a predictive rule so you can find a new output for a new input, even though you haven't seen the corresponding output. We now formalise this process.

The four functions of the mind of a machine that match Vivekananda's functions of the mind: (*chitta, manas, buddhi, ahamhara*) are given by:

1. Algorithm: Memory

AI is really an algorithm, a map from input to output $x \rightarrow y$, denoted by

$$y = f(x), \text{ output} = f(\text{input})$$

The distinguishing feature is that algorithms deal with probabilities rather than certainties. Let $p(y|x)$ denote $p(\text{output}|\text{input})$. Let z denote latent features. Latent impressions in the mind, when activated, can recreate the original experience.

2. Training and Interpolation: Deliberation and Conceptualization

Given empirical observations of output, input pairs denoted by $(y_{(i)}, x_{(i)})_{i=1}^N$ where $y_{(i)} = f(x_{(i)})$ we train the algorithm via Gauss' principle of least squares. This leads to a learned map denoted by $\hat{f}$. Interpolation, then follows from $y_\star = \hat{f}(x_\star)$. We can conceptualize inputs $x_\star$ that haven't occurred yet.

3. Prediction and Action: Determination and Decision-making

A predictive rule is given by $\hat{y}(x) = E(y|x)$. This requires the predictive distribution $p(y|x)$. In many cases, this in turn is a predictive distribution averaged over the beliefs concerning the latent features $p(y|x) = \int_{\mathcal{Z}} p(y|x, z)p(z|x)dz$.

4. Learning: 'Machine' Consciousness

This is achieved by Bayes rule $p(x|y) = p(y|x)p(x)/p(y)$. The updating of beliefs as new information arrives.

We now turn to each component of this process in turn. Machine Learning algorithms are constructed from empirical observation as follows:

Training Given a training dataset of input-output pairs $(y_i, x_i)_{i=1}^N$, the goal is to find a predictive value for a new input $x_\star$, namely $y_\star = \hat{f}_\theta(x_\star)$ for a new input $x_\star$ not necessarily in our training set. The *state of nature* θ is estimated in training by minimising an empirical loss between input, output pairs. Full Bayes uses the maximum a posteriori (MAP) estimator defined by $\hat{\theta} := \operatorname{argmax}_\theta p(\theta|y)$.

Feature Selection: Latent Features z Reduce high dimension space of inputs x to features z . The features can be viewed as a set of "basis" functions to which the mind must be well trained on (a.k.a. have predictive power).

Prediction (a.k.a Interpolation) Given as estimated map $\hat{f}_\theta$ from the "training" dataset, construct a prediction rule, that holds $\forall x \in \mathcal{X}$, denoted by

$$\hat{y}(x) = \hat{f}_\theta(x)$$

Bayesian predictive calculations formally start with a probabilistic model, denoted by $p(y|x)$.

Under predictive mean squared error (MSE), the optimal rule is then given by the mean

$$\hat{y}(x) = E(y | x) = \sum_{y \in Y} y p(y|x)$$

The use of latent (hidden) variables, denoted by z , is an important feature of Bayesian thinking. They can be viewed as "extending the art of the conversation". With latent variables, z , we can write, the optimal predictive rule as

$$\hat{y}(x) = E[E(y | x, z)] = \sum_{z \in Z} \hat{y}(x, z)p(z|x) \text{ where } \hat{y}(x, z) = E(y | x, z).$$

This is simply the law of total probability.

The key insight is that it is easier to assess the inner expectations, the caveat being that we need to evaluate large sums which are tailored made for quantum computers. This includes the case of classification, where we need to evaluate classification probabilities $p(y = 1 | x)$ via expectations of indicator functions.

Bayesian Learning The predictive distribution is given by

$$p(y|x) = \frac{p(x|y)p(y)}{p(x)}$$

The introduction of latent states, z , allows the posterior to be broken into simpler parts

$$p(y|x) = \sum_{z \in Z} p(y|z, x)p(z|x)$$

Again we require enumeration over the latent states z . These expectations can be calculated via von Neumann's quantum measurement simulation as a state of a system. This is similar to the view of a particle filter where the researcher simulates a stochastic process whose marginals over time as realisations of the sequence of posterior distributions that one wishes to calculate.

Deep Learning: Representing f Poincaré showed that any multivariate function can be represented as a superposition of semi-affine functions. A deep learning then is simply a composition of ridge functions and a composition of link functions $f = f_{w_1} \circ \dots \circ f_{w_L}$ where $f_{w_L} = f_L(w_L x + b_L)$ where f_L is a univariate activation function.

Optimisation: Stochastic Gradient Descent (SGD) and Automatic Differentiation (AD) for optimizing parameters and actions/decisions

Principle of Optimality Bellman's principle of optimality describes how to act:

An optimal policy has the property that whatever the initial state and initial decision are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision

—Richard Bellman

Dynamic programming (a.k.a Q -learning) breaks a decision problem into smaller sub-problems.

Quantum Computing: Calculating $\sum_{z \in Z}$ Quantum computers are devices that harness quantum mechanics to perform computations in ways that classical computers cannot. Quantum computing promises an exponential speed-up for Bayesian computation. Quantum state measurement is based on an idea known as von Neumann Measurement where the state of a physical system is used to measure quantities of interest.

The importance of being able to calculate rules, $\hat{y}(x) = \sum_{z \in Z} \hat{y}(x, z)p(z|x)$, that involve a combinatorial explosion $\sum_{z \in Z}$ is expressed clearly as follows

It should now be clear that dynamic probability is fundamental for a theory of practical chess, and has wider applicability. Any such procedure, such as is definitely required in non-routing mathematical research, whether by human or by machines, *must* make use of subgoals to fight the combinatorial explosion ... The combinatorial explosion is often mentioned as a reason for believing in the impracticability of machine intelligence, but if this argument held water it would also show that human intelligence is impossible."

—Jack Good

Reinforcement Learning: Backwards Induction identifies what action would be most optimal at the last node in the decision tree. One can then determine what to do at the second-to-last time of decision. This process continues backwards until one has determined the best action for every possible situation (a.k.a solving the Bellman equation). Equivalently, we can calculate the Q -matrix where $Q(s, a)$ denotes the objective function at state s under action/policy a . The value function is given by $V(s) = \max_a Q(s, a)$ and the optimal policy function, $a_* = \arg \max_a Q(s, a)$.

Exploitation versus Exploration: There is always a trade-off in sequential search problems between exploration and exploitation. Exploration moves us to places where rewards are uncertain and learning needs to be achieved. Exploitation is staying put and collecting rewards where you currently are.

3.2 Human vs Machine Intelligence

Unsupervised Learning What is value to solving? Is it a process of reflection or mental deciphering? Analysis and understanding is a struggle which is mentally good for you, like lifting weights? Does thinking and reflecting help memory, retrieval and extrapolation to new tasks? Learning through the skin with neat handwriting or physical play over the chessboard.

Supervised Learning Can one learn by simply look at question and answer together? This is the input output map training approach. Does this provide an imprint in the mind that you won't forget it. Math and Chess 'look' so much easier after you see the solution.

The Mind and Neural Connections At an "atomic" level von Neumann in *The Computer and the Brain* makes the following estimates for the human nervous system and its accuracy

For the human nervous system: 10^{15} neurons, each neuron activated 10 times per second on average, a mean free path between fatal errors of 60 years which is 2×10^9 seconds. The product is 2×10^{20} . Hence error probability of 0.5×10^{-20} for each activation of an element is required.

—John von Neumann

The process of 'thinking' is central as observed by Vivekananda himself

Education is not filling the mind with a lot of facts. Perfecting the instrument and getting control of one's own mind is the goal

—Swami Vivekananda

A machine is simply a filing cabinet with different possibilities. A procedure or heuristic is an algorithm. Now we can look for similar patterns in the look-up table, the cost of search has been reduced to one of storage, pattern matching and retrieval.

Machines can "make up" heuristics and as AlphaZero shows, in many cases, the machine learns to pay no attention to human input at all!

Deep Learning and Modern AI algorithms are like Jet propulsion. They are excellent pattern matchers, can combine information from multiple sources, e.g. speech and vision. Bayes rule also combines information from multiple sources e.g. searching for submarines. Thus the 21st century is one of harnessing this power.

Feynman In an interview on Artificial General Intelligence (AGI), he compares human and machine intelligence

First of all, do they think like human beings? I would say no and I';; explain in a minute why I say no

Second, for "whether they be more intelligent than human beings: to be a question, intelligence must first be defined. If you were to ask me are they better chess players than any human being? Possibly can be , yes , "I'll get you some day". They're better chess players than most human beings right now!

—*Richard Feynman*

By 1996, computers had become stronger than GMs. With the advent of deep neural networks in 2002, Stockfish15 is way stronger A turning point on our understanding of AI algorithms was AlphaZero and Chess

Chess: AlphaZero AlphaGo coupled with deep neural networks and Monte Carlo simulation provided a gold standard for chess. AlphaZero showed that neural networks can self-learn by competing against itself. Neural networks are used to pattern match and interpolate both the policy and value function. This implicitly performs "feature selection". Whilst humans have heuristics for features in chess, such as control center, king safety and piece development, AlphaZero "learns" from experience. With a goal of maximising the probability of winning, neural networks have a preference for initiative, speed and momentum and space over minor material such as pawns. Thus reviving the old school romantic chess play.

Feynman discusses how machines show intelligence

With regard to the question of whether we can make it to think like [human beings], my opinion is based on the following idea: That we try to make these things work as efficiently as we can with the materials that we have. Materials are different than nerves, and so on. If we would like to make something that runs rapidly over the ground, then we could watch a cheetah running, and we could try to make a machine that runs like a cheetah. But, it's easier to make a machine with wheels. With fast wheels or something that flies just above the ground in the air. When we make a bird, the airplanes don't fly like a bird, they fly but they don't fly like a bird, okay? They don't flap their wings exactly, they have in front, another gadget that goes around, or the more modern airplane has a tube that you heat the air and squirt it out the back, a jet propulsion, a jet engine, has internal rotating fans and so on, and uses gasoline. It's different, right? So, there's no question that the later machines are not going to think like people think, in that sense. With regard to intelligence, I think it's exactly the same way, for example they're not going to do arithmetic the same way as we do arithmetic, but they'll do it better.

—*Richard Feynman*

Feynman also discusses the "AI effect"

As soon as it works, no one calls it AI anymore

—*John McCarthy*

Expertise, Intuition and Creativity Herb Simon understood the relationship between pattern matching and the speed of retrieval

We have seen that a major component of expertise is the ability to recognize a very large number of specific relevant cases when they are present in any situation, and then to retrieve from memory information about what to do when these particular cues are noticed.

Because of this knowledge and recognition capability, experts can respond to new situations very rapidly—

—*Herb Simon*

Simon also asks why decision making is hard. In particular, how does one forget, is a central question in Hindu philosophy which is based on the principle of attachment versus detachment.

Other hard human decisions, e.g. forgiveness, are discussed by C.S. Lewis who provides a probabilistic analysis.

3.3 Machines and Human Work

As a machine is simply a filing system, Feynman asks *What kind of file clerk can't be replaced?* Turing warned of this loss of work as he foresaw the development of the computer age. Keynes took the view that machines by producing more digital content will increase our leisure time and ought to be good for mankind. In a digital age with powerful AI algorithms, Vivekananda's philosophy is evermore relevant. One should train the mind for concentration and detachment, not collection of facts, as Google search and suggestions retrieves information for you. However, most humans are too busy to sharpen the mental axe. In a digital age, where information moves faster than the speed of light, humans refuse to admit that machines are better at thinking. We always want to be in control and machines take our decision making powers away. Machines can do physical things, lifting large weights, much better than humans and we don't worry about it!

Computers do tasks and increase speed. Machines don't think like humans. Intelligence is the same way. But they do it better, faster and differently—but fundamentally the same answer. Humans are full of errors—machines are better. Moreover, machines don't forget due to superior storage and retrieval mechanisms. Feynman provides a simple test, list twenty numbers, then repeat back in reverse order. Hard for humans, easy for machines.

The human tendency is to want to dominate and decide how things unravel in the future. With deflection and traps on the way. As Milton's truth seekers strive for plain talk and transparency, as otherwise the status quo stays. Humans often "add features" that are irrelevant just to feel "good".

Turing In a 1947 lecture at Royal Mathematical Society he described how machines think but also implications for human endeavors by predicted the automation of high-value jobs—held by what he called "masters" as opposed to the "slaves" operating the computer—and the possible defense mechanisms by what today we call "knowledge workers":

The masters are liable to get replaced because as soon as any technique becomes at all stereotyped it becomes possible to devise a system of instruction tables which will enable the electronic computer to do it for itself... They may be unwilling to let their jobs be stolen from them in this way. In that case they would surround the whole

of their work couched in well-chosen gibberish, whenever any dangerous suggestions were made.

—Alan Turing

Turing concluded his lecture with a plea for expecting intelligent machines to be no more intelligent than humans:

One must therefore not expect a machine to do a very great deal of building up of instruction tables on its own. No man adds very much to the body of knowledge, why should we expect more of a machine? Putting the same point differently, the machine must be allowed to have contact with human beings in order that it may adapt itself to their standards.

—Alan Turing

Manfred Spitzer is a German neuroscientist, who has spent much of his life researching digital dementia. Consuming digital information has a large effect on the human mind —particularly in children—which can be detrimental. The training of a child’s neural connections should be via connection between the senses; for example, learning how to throw balls, climb trees, running rather than sitting passively in front of a computer screen. Brain scans show dramatic differences in function between extreme video gamers and others—the brains of gamers exhibiting the same neural patterns as old dementia patients. Clearly, the physical process of running and catching a ball builds a ‘basis function’ for vision—even though one doesn’t need Newton’s laws of motions to catch a ball. Deep learning provides a similar pattern matching approach in AI.

There are a number of caveats, changing rules can have a drastically different optimal solution. Will machines learn the necessary weakness of intelligence, for example, to do no labor, or the psychological distortions in humans such as habit formation where people always do the same thing and get stuck in patterns and actions.

We now turn to Education and Learning.

4 Discussion: Education and Learning

Vivekananda in his book *Education* outlines his views on the topic

Education is the manifestation of the perfection already in man

—Swami Vivekananda

The transmitter (guru, coach, teacher) of information has an important role to play, however

The mistake of the teacher is to think he’s teaching

Swami Vivekananda

How should one set about the process of learning? What should a person learn? Clearly there is an allocation problem of time and effort

The problems of education are further complicated by the mushrooming of both data and theories. Hence, we must not only teach what is, but in addition the ability to comprehend and use what will be. We need therefore not only algorithms, but algorithms for

constructing and interpreting algorithms. Students must learn to recognize, understand and use adaptive control processes.

—Richard Bellman

Richard Feynman provides some insights on how to organize and retrieve information in a method known as the *Feynman Technique*.

Feynman Technique: How to Learn

Subject Choose a concept you want to learn about. Identify the subject. Write down everything you know about the topic. Each time you run into new sources of information add them to the note. Feynman used to keep a 'notebook of things I don't know about'.

Explanation Explain it to a 12 year old Start with a blank note and write the topic or subject you want to teach. The trick is to write it plainly and simply: speak in plain terms, brevity.

Reflect, Refine and Simplify What are you missing? What do you know?

Organize and Review Transmit concepts and ideas. Put together your notes and provide concise explanations. Use analogies and simple sentences to strength your understanding of the story.

I want to convey in emotions I have about the beauty of the world. It's difficult to describe because it's an emotion, it's a feeling of awe of scientific awe.

—Richard Feynman

To test your understanding in the real world, run it by someone else. How effective was your explanation? What questions did they ask? What parts did they get confused about?

Instead of committing his knowledge to paper, he choose to use speeches as foundation forming of his published works. Feynman dictated most of this books and his scientific papers were transcribed from his lectures.

Counterfactuals Humans have the ability to entertain different paths and weigh them in decision-making. Counterfactual thinking that other animals can't.

Contradiction For example, an interesting math problem regarding the primes illustrates that argument by contradiction.

Show that there's an infinite number of primes. Argue by contradiction. If not, we can list then $p_1, \dots, p_n$, then consider the number $p = p_1 p_2 \dots p_n + 1$. Not divisible by any in the list, therefore prime (and not in list). A contradiction. Therefore, there's an infinite number of primes!

The 'basis function' or 'feature selection' approach of AI algorithms can also be used to provide 'test case' examples for the human mind to train on, either via unsupervised or supervised learning Math is complex with so many variations. Asking whether you are good at math silly is like asking if you are good at all shades of colors. Which 'features' are you knowledgeable about?

Primes Find the smallest number that when multiplied by 2 is a perfect square, and when multiplied by 3 is a perfect cube.

Rather than just checking by brute force, consider the prime factorisation: Hence answer is $2^3 3^2 = 72$

Essentially once one has learned the prime factorisation basis (a.k.a. features) from empirical observation, the essential set of features allows us to answer questions we have never seen before with speed and accuracy. The interpolation property of AI/Deep Learning algorithms as well.

The construction of algorithmic approaches and data-based learning needs a fine balance

The task of achieving a suitable balance between ideas and facts between algorithms and data, is basic to the educational process. Since teachers are given a limited time within which to train and influence the student, they constantly face allocation processes: what to teach when, and for how long. If we could retain all of the facts that are available, who would need the groupings and categorizations that are often called "theories"?

—Richard Bellman

Thus providing a goal future for human-machine guidance. There is an unreasonable effectiveness of mathematics and data.

Education One should enfuse the mind which naturally loved to solves puzzles. The mind is naturally curious, ever exploring and exploiting its knowledge. Seeking data and new things as data arrives. At all ages, how people puzzles and allow the joy and delight of solving them. In many ways, life is a detective story and finding out who dun it as in Sherlock Holmes.

Sherlock Holmes Data collection and storage is simply an interaction between the senses and the mind. A detective story. Maria Konnikova's book *How to think like Sherlock Holmes* describes the attention to fine detail and instantaneous recall that Sherlock possessed. Sherlocked asked Watson: *How many steps up to 22 Baker street?* Watson: I don't know Holmes, Sherlock: 17 Watson.

Artificial General Intelligence AGI is dealt with in the movie *Ex Machina* where the Latin term '*deus ex machina*' is a translation of a Greek phrased and means literally '*a god from a machine*'.

Feynman's views are given in [Artificial General Intelligence](#).

In his essay on *Economic Consequences for Our Grandchildren*, written in the mists of the depression, Keynes predicted that the accumulation of wealth associated with market forces will solve all our economic problems.

The asymptotic limit is human leisure

—John Maynard Keynes

In sum, two mantras

Educate yourself to protect yourself from the educated

—Shiva's Dad

Don't get philosophical on me

—*Nick to Shiva*

Finally, a reflection on the opening quote

Anything that makes you weak, physically, intellectually and spiritually, reject as poison

—*Swami Vivekananda*

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