

INFORMATION HIDES IN THE GLARE OF REALITY.

“At the heart of everything is a question, not an answer” – Wheeler.
Or is it the opposite?

The answer is staring at us with all its glory, but its glare blinds us!

Why of all the number systems in use, binary systems dominate the information sector? What reality stands for? How virtual particles pop out and vanish in the so-called vacuum states? By which mechanism information (thought) pops out of memory in response to some external stimuli and vanishes again? What is an electron or a photon? What will happen if proton or neutron is used in the double slit experiment? Does Big bang imply ex-nihilo? What is nothingness? Is there an all encompassing background structure? Can energy be non-interacting (dark)? As Jesus says, let those who have eyes see.

THE ITS & THE BITS:

Information Theory is based on the concept of writing instructions that will make the computer follow and run a program based on those instructions or matching perceptions of the transmitter with the receiver. Perception is the processing of the result of measurements of different but related fields of something with some stored data to convey a combined form “it is like that”, where “it” refers to an object (constituted of bits) and “that” refers to a concept signified by the object (self-contained representation). Measurement returns restricted information related to only one field at a time. To understand all aspects, we have to take multiple readings of all aspects. Hence in addition to encryption (language phrased in terms of algorithms executed on certain computing machines - sequence of symbols), compression (quantification and reduction of complexity - grammar) and data transmission (sound, signals), there is a necessity of mixing information (mass of text, volume of intermediate data, time over which such process will be executed) related to different aspects (readings generated from different fields), with a common code (data structure - strings) to bring it to a format “it is like that”.

In communication technology, the mixing is done through data, text, spreadsheets, pictures, voice and video. Data are discretely defined fields. What the user sees is controlled by software - a collection of computer programs. What the hardware sees is bytes and bits. In perception, these tasks are done by the brain. Data are the response of our sense organs to individual external stimuli. Text is the excitation of the neural network in specific regions of the brain. Spreadsheets are the memories of earlier perception. Pictures are the inertia of motion generated in memory (thought) after a fresh impulse, linking related past experiences. Voice is the disturbance created due to the disharmony between the present thought and the stored image (this or that, yes or no). Video is the net thought that emerges out of such interaction. Software is the memory. Hardware includes the neural network. Bytes and bits are the changing interactions of the sense organs (string) with their respective fields generated by the objects evolving in time.

The result of measurement is always related to a time t , and is frozen for use at later times t_1, t_2 , etc, when the object has evolved further. All other unknown states are combined together and are called superposition of states. Hence there is an uncertainty inherent in it, which Shannon calls entropy. In perception, the concept remains in a superposition of states and collapses in response to some stimuli. In information technology, the updating is done by an agent. In perception, it is done by the neural network and memory. All information has a source rate (complexity) that can be measured in bits per second (speed) and requires a transmission channel (mode) with a capacity equal to or greater than the source rate (intelligence or memory level). In perception, these are the intelligence level and mind.

Nature follows this principle for storing and processing information. The nature of energy is to displace, which leads to transformation. Objects are perceived only during such transition. Such transitions involve standing waves, which also generate sound. Thus, perception includes audio-visual aspects or e.m. and sound waves. A wave, by definition, is continuous. A particle is discrete. Hence something can be described both as a wave and a particle only at a point - the interface of two waves. The photon consists of two standing waves of force - one an expansive electro force and the other the contractive magnetic force. When these waves intersect each other perpendicularly, it is called an electromagnetic particle. The particle vanishes as the forces separate in their continuation as standing waves. *Photon is the locus of this interface in a direction perpendicular to both.* Hence it is called the carrier of e.m. energy and has no rest mass. A wave always requires a medium. Since density plays an important role in momentum transfer and since density of space is the minimum, the velocity of photon in space is maximum.

A sound wave is perturbations of density, pressure and velocity, where sites of maximum density alternate with sites of minimum density to generate and propagate the vibrations. They are distributed periodically and propagate in the medium with the velocity of sound. The wavelength is a weak perturbation, where the relative values of the density amplitude (i.e., the greatest value of density, divided by the average density of the medium) is small as compared to unity. If we take a sound wave of large amplitude, the pressure and temperature in the maxima of density prove to be noticeably greater than their average values. The velocity of sound at these maxima is also greater.

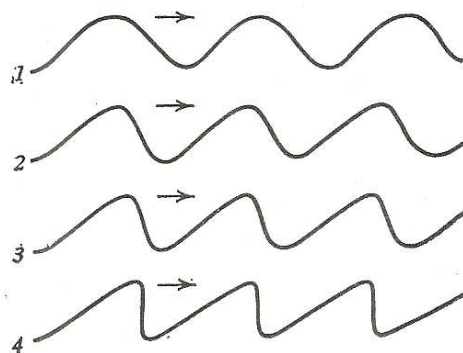


Figure 1.

Evolution of a sound wave. Density profiles are shown in four successive instants. The arrows show the direction of the wave propagation.

Due to the above reason, the crests of the wave propagate in the environment faster than the wave as a whole. Similarly, the velocity of sound at the minima of density is less than the average velocity. Hence the troughs move slower than the whole wave and the crests tend to overtake the troughs. When a crest gets closer to a trough, the layer of the density drop becomes narrower and the wave front becomes steeper. If the crest could catch up and overtake the trough, the wave front would turn over like those in the sea. This causes background noise in communication and confusion in perception.

MECHANISM OF PERCEPTION:

To understand or solve something is to predict its behavior in a given situation, when such prediction matches observed behavior. Something makes meaning only if the description remains invariant under multiple perceptions or measurements under similar conditions through a proper measurement system. In communication, as in perception, it is the class or form that remains invariant as a concept. The sequence of sound in a word or signal ceases to exist, but the meaning remains as a concept. In Nature, same atoms (or numbers signifying objects) may combine differently to produce different objects. The concept arising out of each combination acquires a name (word, message) that remains invariant through all material changes and even when they cease to exist.

This also defines reality. Reality must be invariant under similar conditions at all times. The validity of a physical theory is judged by its correspondence to reality. In a mirage, what one sees is a visual misrepresentation caused by the differential air density due to temperature gradient. All invariant information consistent with physical laws, i.e. effect of distance, angle, temperature, etc, is real. Since the perception of mirage is not invariant from different distances, it is not real.

The concept of measurement changed with the problem of measuring the length of a moving rod. Two possibilities suggested by Einstein were either to move with the rod and measure its length or take a photograph of the two ends of the moving rod and measure the length in the scale at rest frame. However, the second method, advocated by Einstein, is faulty because if the length of the rod is small or velocity is small, then length contraction will not be perceptible according to his formula. If the length of the rod is big or velocity is comparable to that of light, then light from different points of the rod will take different times to reach the recording device and the picture we get will be distorted due to different Doppler shift.

Length contraction is only apparent from the stationary frame and cannot be real for the moving frame. What the man on the platform sees cannot affect the train. The passenger on the train will not notice any length contraction. However, time dilation is real in a different sense. All experiments conducted to prove time dilation are defective. Data from the first experiment available in US naval archives proves that it was fudged. Time dilation has meaning only in relative terms of cyclic evolutionary sequences. The evolutionary cycles are different for different categories or different species of the same category. Their evolution over universal time (Einstein's clock at C) can lead to comparative time dilation.

In communication, length contraction or time dilation has no direct bearing on the final outcome. Yet, the individual letters in a word or the individual words in a sentence submerge their sovereignty to the final meaning. Further, the same concept can be communicated by using long or short words or sentences that take different time to pronounce or write. When the compiler translates the code into assembly language or the assembler converts the assembly language into computer code or the computer executes them into a series of 'on's and 'off's, the effect of these concepts are evident.

Writing a code means writing a bunch of relatively simple instructions and allowing the computer to run millions of instructions in a second. Individually, each code line does very little. The programmer not only focuses on what the end product looks like, but also on how each little piece runs, and then being able to write all of the little lines of code that enable the whole program to run. Finally, the program objective is broken up into different chunks. Only the chunk that is needed is worked on at a time and those that are not needed are pushed off to be done at a different time. This enabled writing more complex codes, but made it more readable and easy to program.

The inherent uncertainty induced by the environment necessitates error-correcting codes. This is done by introducing redundancy into the digital representation to protect against corruption (syntax error). Compilation of information (pool) is bound by physical rules and all combinations are not permitted (eigenvalues). Inside an atom, the number of neutrons cannot exceed a specific ratio. This is the difference of wakeful state from the dream state, where, in the absence of external stimuli, no such restrictions (compiler) apply to the stored information in memory. Hence valid source coding is necessary.

In the mechanism of perception, each sense organ perceives different kind of impulses related to the fundamental forces of Nature. Eyes see by comparing the electromagnetic field set up by the object with that of the electrons in our cornea, which is the unit. Thus, we cannot see in total darkness because there is nothing comparable to this unit. Tongue perceives when the object dissolves in the mouth, which is macro equivalent of the weak nuclear interaction. Nose perceives when the finer parts of an object are brought in close contact with the smell buds, which is macro equivalent of the strong nuclear interaction. Skin perceives when there is motion that is macro equivalent of the gravitational interaction. Individually the perception has no meaning. They become information and acquire meaning only when they are pooled in our memory.

In the perception "this (object) is like that (the concept)", one can describe "that" only if one has perceived it earlier. Perception requires prior measurement of multiple aspects or fields and storing the result of measurement in a centralized system (memory) to be retrieved when needed. To understand a certain aspect, we just refer to the data bank and see whether it matches with any of the previous readings or not. The answer is either yes or no. Number is a perceived property of all substances by which we differentiate between similars. Hence they are most suited for describing messages concerning everything. Since the higher or lower numbers are perceived in a sequence of one at a time, it can be accumulated or reduced by one at each step making it equivalent to binary systems.

The probabilities on which Shannon based his theory were based on objective counting of relative frequencies of definite outcomes. Physics uses an elementary, indivisible entity - quantum - defined by the act of its observation, to build everything. So does information theory. Its quantum is the binary unit, or bit, which is a message representing one of two choices: 1 or 0 – on or off – yes or no. The ‘on’s are coded (written in programming language) with 1 and the ‘off’s with 0.

CLASSIFICATION OF INFORMATION:

Information is specific data reporting the state of something based on observation (measurements), organized and summarized for a purpose within a context that gives it meaning and relevance and can lead to either an increase in understanding or decrease in uncertainty. Information is not tied to one’s specific knowledge of how particles are created and their early interactions, just like the concepts signifying objects are not known to all. But it should be tied to universal and widely accessible properties. Information theory tries to make the concepts opaque to the less privileged. Two widely used theories are the Shannon’s mathematical theory and Chaitin’s algorithmic theory.

Chaitin used a version of Gödel’s incompleteness theorem. Using an information theoretic approach based on the size of computer programs, he found regions in which mathematical truth has no discernible structure or pattern and appears to be completely random. Hence he used statistical laws to build computable strategies. We dispute his undecidability theorems which equates very small to zero. We are not discussing it now.

Shannon dealt with Channel Capacity & the Noisy Channel Coding Theorem, Digital Representation instead of electromagnetic waveform, Efficiency of Representation - Source Coding (data compression) and Entropy & Information Content. The channel capacity can be approached by using appropriate encoding and decoding systems. The noisy channel coding theorem gave rise to the entire field of error-correcting codes by introducing redundancy into the digital representation to protect against corruption below certain threshold – Shannon limit. Digital representation ensured that once data was represented digitally, it could be regenerated and transmitted with minimal error. Source Coding removed redundancy in the information to make the message compact. Shannon showed that information could be sent using high power and low bandwidth (brevity), or high bandwidth and low power (expressiveness).

The traditional low bandwidth radio focused all their power into a small range of frequencies. With increasing number of users, the number of channels used increased and so was interference. Since too much power was confined to a small portion of the spectrum, even a single interfering signal in the frequency range could disrupt the communication. Shannon redefined the relationship between information, noise and power. He quantified the amount of information in a signal as the amount of unexpected data the message contains. He called the information content of message ‘entropy’ or uncertainty.

In digital communication, a stream of unexpected bits is just random noise. Shannon showed that the more a transmission resembles random noise (common usage), the more information it can hold, as long as it is modulated to an appropriate

carrier - a low entropy carrier can carry a high entropy message. He could send a message with low power spread over a high band width by spreading its power over a wide band of frequencies. One problem with his model that differentiates it from intelligent models like perception is that, it does not consider message importance or meaning that concerns quality of data.

The second category of information is factual information, which is the content. The Shannon information involves messages represented by symbols (usually binary numbers) and probabilities of their being chosen. But what is the content of the messages? All sounds do not convey a message. When we say "pen" – a sound symbolizing three letters (symbols) arranged in a particular pattern, what is the content of the message for the receiver? To someone who can't hear or does not know English or have not seen a pen or knows the pen by some other name, the word "pen" or the object does not make any sense. If he has come across this word earlier and has known to relate the sound to the object, only then he can think that "It is like the one I had seen earlier, which was called a pen. Hence it is a pen". Thus the actual content of any word is the concept of a known object.

The particular structured configurations of letters are words that convey a fixed meaning. The binary symbols only conform or deny whether the perception of the object matches the concept or not, but not the probabilities of their sequence or occurrence. Shannon followed the Morse code, which worked on the probabilities of their sequence or occurrence. Several words can be formed with the same set of letters. A particular configuration conveyed a particular meaning. The same object may be associated with different words by different receivers. The same word may convey different meanings in different contexts. The probability of any specific word being chosen over others rests with the understanding level of the receiver and depending upon the environment. This is determined by experience and not due to uncertainty.

Just like the result of measurement is preserved for future requirement, the fixed meaning assigned to words (concepts) is also preserved in Nature. For example, inertia of motion starts after an impulse, which makes a body move in a field imparting energy to it at the point of contact. It gradually diminishes when other opposing force components act upon it. Since energy cannot be destroyed, the energy of the body in motion is transferred to others. Similarly, when we perceive something due to an impulse, it starts inertia in our mind by generating a chain of thoughts drawing from memory. This chain ceases if we get the object of our desire or know all about it or experience some pain due to another stronger impulse. In this process, the energy that generated thought is transferred to the field that gave rise to the perception.

Our thoughts consist of words with etymological or fixed meanings (variables and constants), which are preserved in Nature. Thus, along different cultures, we find similarities in the words signifying similar concepts like mother, father, brother, five, seven, etc. When perceptions of such words (sounds) or symbols (visuals) are mixed (array) with the perception of the object, the message is complete. When we see a person singing in a TV program, we perceive it as "the person my eyes see is the person whose songs my ears hear". This is due to the mix of the two different perceptions in our brain.

The third category of information is intrinsic semantic information. Semantic means pertaining to different meanings of words or other symbols. It relates to configuration that carries intrinsic information in the sense that different persons can, in principle, deduce the law or process that explains the observed structure. Here, the grammatical meaning has been discarded fully or partially for a different meaning because of similarities associated with the concept. It is popular usage or special programs that may or may not follow general logic, but follows a law of its own.

The fourth category is the control statement. The computer is programmed to go straight from the first line of code to the last. But if we want it to run some code only on some conditions, it changes control to read from a different line of code, instead of the next. We can even put one control statement inside another or use a pseudo code.

The last category belongs to some axiomatic postulates (operations and operands) that are accepted as evidently proven (primitive) in communication. This is essential for programming. For example, unless we accept the concept of numbers and the binary system as self-evident truths, we cannot start writing a program.

Classically, we used grammar, dictionary, synonyms, public usage and adages respectively for these categories of information.

WHAT HAPPENS IN NATURE?

According to the Church-Turing principle, every piece of physical reality can be perfectly simulated by a quantum computer. But there is difference between Reality and its simulation. Formulating a Theory of the observed (or potentially observable) events means building up a network of input-output connections between them. In a causal theory, these connections are causal links. In computer-programming language, the events are the subroutines and the causal links are the registers where information is written and read. In physical terms, the links are the systems and the events are the transformations. The computer does not function naturally, but we design and write the algorithm for the computer to function. Hence it will be a creature of our ideas and limitations – GIGO. The notion of Information cannot become the new big paradigm for Physics.

Wheeler's delayed-choice experiment is a variation of the two-slit experiment, where the experimenter decides whether to leave both slits open or to close one off - after the electrons have already passed through the barrier. The electrons are said to know in advance how the physicist will choose to observe them. This experiment was carried out in the early 1990s and is said to confirm Wheeler's prediction. But has anyone ever tried to do the experiment with protons and neutrons, which are also quantum particles?

While conducting experiments, most people exclude the properties of the measuring instrument that affect the outcome. If you throw a pebble to the surface of a pond, the pebble goes down, but the waves spread perpendicular to its direction. If we throw another pebble a little away from the first pebble, the pebble will sink below, but the new waves on water will show interference pattern. Something similar happens in

two-slit experiment. A moving electron generates a magnetic field that moves perpendicular to it. We have conducted some experiments in a water body with separated channels. Interference pattern was seen when the waves had access to both channels, but not seen when one channel was blocked. Our experience also links the interference pattern to the distance of the barrier from the slits. An experiment using protons and neutrons will show similar behavior.

In a recent experiment of two-slit experiment, a gold-coated silicon membrane with two slits each 62 nm wide and 4 μm long with a separation of 272 nm was used. To block one slit at a time, a tiny mask controlled by a piezoelectric actuator was slid back and forth across the double slits. Piezoelectric effect is the generation of an electric charge in certain non-conducting materials, such as quartz crystals and ceramics, when they are subjected to mechanical stress. Piezoelectric materials exposed to a fairly constant electric field tend to vibrate at a precise frequency with very little variation. Since the electrons were created at a tungsten filament and accelerated across 600 V and collimated into a beam and the intensity of the electron source was set so low that only about one electron per second was detected, the mask that controlled the barrier was interfering with the results. Hence the entire set up is faulty.

Till date no one has described “**what an electron is**”. To understand it, we have to look at the Solar system as reported by Voyager 1. The solar radiation moves out in all directions gradually reducing in energy with the passage of different planetary orbits to face resistance at the termination shock. After passing through the heliosheath and heliopause, it meets a transition region before crossing the heliosphere. In an atom, these are equivalent to the electron orbits. The electrons are the locus of the nucleic radiation at the resistance points of the nucleic field, confined by the negative charge band of the field. Thus, they behave like waves in the sea till they hit the shore. When they pass or are directed through only one slit, they show one pattern. When the two slits are open, if the distances in both sides are right, they show interference pattern. Elsewhere we have explained entanglement with macro examples. There is no quantum weirdness.

How do atoms get instructions about the laws they must obey? Density variation in the field generates different strings that are revealed as the fundamental forces of Nature, just like the sequence of letters create words with specific concepts. Most of the “instructions” are really interactions (mechanical reaction or as induced by a conscious agent, which again are reduced to mechanical reactions). The second law of thermodynamics proves this. The information lives in the Universe as the physical counterpart of a background structure – maintaining a state of equilibrium. When disturbed, the tendency for maintaining equilibrium generates two complementary forces: inertia of motion and inertia of restoration (elasticity). These forces can act linearly or through a point in the field at equilibrium. This creates non-linear behavior that leads to different confinements which are experienced as different forces of Nature.

What is the substrate within which space and time are encoded in this description? Matter itself is patterns of fields in space and time. Particles are nothing but locally confined fields of different densities. Both space and time are related to the order of arrangement in the field, i.e., sequence of objects and changes in them (events) as they evolve. The interval between objects is space and that between events is time.

Both space and time co-exist like the fundamental forces of Nature. Similarly, the sequential arrangements of letters form words with different concepts conveying fixed meanings.

Application of force can be of two types: application by a conscious agent or perpetual application of mechanical force, i.e., temporal evolution. Knowledge is the initial condition for application of force by a conscious agent. Incompleteness of our knowledge brings in instability that generates the inertia of motion and inertia of restoration to induce the conscious agent to apply force. The reaction, when compared with previous data, becomes knowledge – real or imaginary. Since result of measurement is fixed, knowledge is in a state of equilibrium. There is a continual pressure starting from the creation event to achieve complete knowledge. If we can have full knowledge, there will be no inertia of motion or restoration – hence no application of force, no measurement, no perception and no knowledge to describe anything. This incompleteness propels creation.

In the case of perpetual motion, which forms the background in which all natural information is stored and physical objects evolve, we can't control it as it does not interact, but we can have indirect knowledge about it. Big bang did not imply ex-nihilo. If there was no background, what the Universe is expanding in to? When we deny the existence of something, we only deny its physical existence at here-now. We cannot deny the existence of the very concept.

Quantum states give only probabilities, which are determined by observation. The probability is related to the observer's inefficiency to control the environment and not to the way the quantum world behaves. They pop out and vanish following general rules of momentum transfer. The hidden variables are the characteristics of the background structure on which the fields rest. These are equivalent to etymological meanings and fixed meanings of words. A field, which is a continuum, cannot exist in void – nothingness. Even the interacting quantum systems - a quantum computer - need a base to exist.

Cosmologists count the number of super-clusters of galaxies in volumes of 300 Mpc or more in size, to find their average concentration in space. Knowing galactic masses, they estimate the average density of matter in such volumes. This density is the same $3 \times 10^{-31} \text{ g/cm}^3$ or about one hydrogen atom per 30m^3 , wherever we take a volume in space. Can they exist in a void? The huge range of temperatures found in different locations in the Universe and the consistency of background radiation at 2.73k shows the universal background structure. This is the real dark matter. We have discussed the galaxy rotation problem elsewhere. The galactic clusters spinning around a center appear to be temporarily moving away like planets sometimes appear to move away from each other to close in later. The galaxies are not receding due to dark energy as the effect is not seen in galactic scales or less. They are not expanding. Energy is perceived only through its interactions. Hence it cannot be dark (non-interacting). Similarly, information cannot be dark (without answers). It shines in full glory blinding us. We should have the eyes to see it.