Rupam Drisyam lochanam drik | Tat drisyam drik tu manasam
Drisya Dhibrittaya sakshi | drigye na tu drisyate

Form (*Rupam*) is seen (*drisyam*) by eye (*lochan*), the seer; that (*tat*) eye is seen by the mind-seer (*manasam*), the modifications of the mind (*Dhibrittaya*) are seen by the eternal seer, the atman, the eternal sakshi; the atman (self, *drigye*) is always the seer but never the seen.

Panch rang nirkhe tat sara | Chamak bijli chandra nihara | Fora til ka dwara ho

The concentrator saw the five elementary colors (*pancha rang*) of the five fundamental elements that compose the universe, beheld the flashes of lightening of the moon (chandra), and then, forced upon the third eye (*fora*), viz., the portal of the universe (*til ka dwar*).

5 Big Data in the Garden of Gardens (GOG)—Universal Time Crystal

5.1 GÖDEL'S INCOMPLETENESS THEOREM AND THE FRACTAL TAPE

The grand old photon: We know that a photon keeps time by traveling with the velocity of light. When a photon comes to our eyes from a distant galaxy, for that photon there is no time lapse in the travel. It touches the surface of the star and our retina cells and everything in the universe at the same time. Since the time of the Big Bang, the universe might have expanded for our frame of reference but for a photon it has remained static. The photon still lives in the time of the Big Bang. The concept of time lapse starts when we come out of a photon's frame. To describe several events occurring simultaneously, we are forced to state each step, one after another, just because our machine reads only one bit at a time. The architecture of time or time crystal is a many fold temporal correlation between any two bits of information; time moves in many directions. Now, "loss in parallelism" due to sequentialization needs to be avoided, but managing the flow of time with phases at many layers is not an easy task. A single time crystal can have many system points at a time. The pairing of only two events by completely neglecting the possibility of coupling three or more events is an unrecoverable weakness that affects through the complete destruction of higher-level logic in a Turing tape system. Since a time crystal does not forcefully linearize a one-to-many and many-to-one network, it captures "simultaneity." In conventional computing science, we strictly confine ourselves within the concept of pairs, two elements interact at a time. The concept of higher-level logic encompassing a group of arguments links all contributing elements at a time. Then we do not have to pinpoint accurately where, exactly, our desired information is located.

The singularity dilemma: Imagine we have a technology to slow down or speed up photons so that we can control the flow of time (Panarella, 1987). Suppose now we are solving a math problem for a natural process that is slow, we speed up the computing time and get the solution faster. Standard computing problems are shown to truly benefit by manipulating time, e.g., via satisfiability (Schnorr, 1978), by checking the isomorphism in trivalent graphs (Galil et al., 1987); by generating the parallel hierarchies (Bloch, 1997); possibly by tuning an infinite time Turing machine (Hamkins and Lewis, 2000); etc. Close time like curve are loops where the system point returns to the same space-time location after a closed motion. In such loops, all pixels on the perimeter coexist at a time, it is naturally engineered to squeeze or expand time flow by changing its diameter (Van Stokum, 1937). It can solve hard problems (Brun, 2008) and bridge the gap between classical and quantum computing (Watrous and Aaronson, 2009). One very exciting thing about the quantum clock is its direction of time. Can we set it, and if we do, would it remain as a quantum clock? Where defining the length of a path is not legitimate, the perimeter of a closed-loop would coexist in many paths at a time (Abbott and Wise, 1981), the most reported quantum clocks use a hidden classical certainty, just like a quantum logic gate. Thenceforth, Reddy et al. have proposed a new kind of clock, whose pixels in the perimeter are also clocks, so, as we zoom the pixel, we go deeper and deeper

into an endless chain of clocks. It is neither classical nor quantum. In standard time series of signals, a self-similar pattern is searched (Kantelhardt, 2011; Shlesinger, 1988) and termed as a fractal clock. In contrast, the shortest time of a fractal clock is a circle, if zoomed, it is a clock too, so, a piece of time anywhere in the network remains undefined, we get singularity everywhere. Since singularity is undefined, tons of differential equations are not useful at all, so does a fractal clock, consequently, we encounter a singularity dilemma.

When Darwin drives Gödel's incompleteness: Both truth and false does not exist: Turing's world of computing and Darwin's theory of evolution are two concepts that are apparently unrelated, but, stems from a similar fundamental ground "matter holds its complete properties" and binary true/false argument. Historically, both the philosophies have undergone multiple eclipses and reincarnation of Turing and we look beyond the completeness philosophy and binary arguments, where the logical statements are composed of multiple truths. Hence there is nothing as the truth and nothing as the false, to hold and process a matrix of truths with analog values, we need "symmetry + energy" duality, then, no arguments are isolated, everything is interconnected just like a many-body system. It leads to the philosophy of information fractal,—very different from the fractal holographic universe and other fractal models of the human brain and that of the universe. Information fractal means we do not care how the hardware looks like its resonance band is a fractal, also we emphasize on escape time fractal not the iterative function system. Here, due to escape time fractal tape network, a point carries infinite numbers of scales inside, but just by reading it one cannot explain the entire universe. Phase prime metric (PPM); geometric musical language (GML); and fourth-circuit element, Hinductor or H-based triangular computation has one argument, one energy packet, one Turing like tape, one clock, one rhythm, one oscillator that encompasses the entire universe, but if we enter inside, we find millions of that inside, the journey continues forever to the Plank scale. The zoom-journey inherits a fractal culture, but there is no absolute self-similarity at any scale, since primes do not repeat.

Gödel's incompleteness theorem: First theorem: Say we have a bag of arguments, now by combining all these arguments in all possible ways, we can generate several axioms, none of them would be new as outlined in the Figure 5.1a. Axiom means a primary theorem. To create truly any new axiom, we have to bring some arguments from outside the bag, if we don't bring new arguments from outside the bag, the newly produced argument is already there. Starting set of arguments is always incomplete to create anything new, if we bring anything from outside, that again changes the bag we start with. Second Theorem: If we have an axiom that includes all arguments inside the bag and some arguments that were brought from outside to make it new, then the axiom is incomplete.

Quin's *what there is*, Plato's *beard*, Bertrand Russell's *Theory of Descriptions* (RTD), and Wyman's "*unactualized possible*": Plato's beard suggests that if we state something does not exist, the statement is itself a piece of evidence for its existence. By Quine's argument (Quine, 1980) Plato's beard argument does not hold good because no claim is made in the statement that it does not exist. The positive argument is an argument, the negative argument is not. Wyman adds that a statement that something does not exist means it cannot be found in reality as a spatio-temporal entity. Russel's theory of descriptions considers a statement as a point object and links it to all that could build a connection and then all that are not linked. That way, RTD splits a statement into three parts, "that," "everything," and "nothing." For PPM-GML-H triad (Phase prime metric-Geometric musical language-Hinductor), we find a set of symmetries associated with it, philosophically it means association with universal similarities of primes. Thus, triangular split suggested by RTD is applicable here with a twist "that" evolves as a composition of "everything" and "nothing" in the PPM. Two entities "everything" and "nothing" are "geometric shape" and "phase space," respectively, in the GML. Two entities are realized in the fourth-circuit element, Hinductor (H) as "knots of darkness" and "vortex of light." Together, the triad covers a tiny part of an infinite time domain of the universe (Figure 5.1b).

Evaluation of PPM with respect to the butterfly effect, chaotic and random or deterministic features: Chaotic system is absolutely predictable if we know the initial condition this is called the butterfly effect. Now, one can theoretically calculate the future of the system. But for us even if we do not know the initial condition, rather a part of the entire system, we can still get it. Like the weather, we cannot predict more than a few days because input conditions do change. But we can have a situation when we should be able to resolve this issue also. We are neither "chaotic (if known input, then tell output)," "random (even if we know the input, cannot predict)" nor "deterministic," it is "quasi-deterministic," always reaching toward determinism, but being an asymptotic function, determinism is never reached, like a fractal tape (Figure 5.1c). The same run would give different result in two consecutive runs, like a classic random system.

Self-referential systems with time as primordial category following Peirce: Thus far no attempts were made to build a technology that is a self-referential system. The biggest hurdle was the criterion that the system would deduce the axioms by itself and then it would be so original that for any deduction, it would only refer to itself. The demand is like, "we cannot find the Shangri-La in the Himalayas, unless we know where it is." PPM is theoretically the system that can deduce the axioms using geometric musical language, GML. Now, true processing of the PPM–GML system is possible only if we use the fourth-circuit element, Hinductor (H), and build hardware that reflects PPM. Thus, PPM-GML-H triangular system is a self-referential system. The time crystal architecture and the electromagnetic resonance band feed each other (Figure 5.1d). In this system, time is a primordial category free of any form of interaction from outside. Peirce suggested that this happens if closed

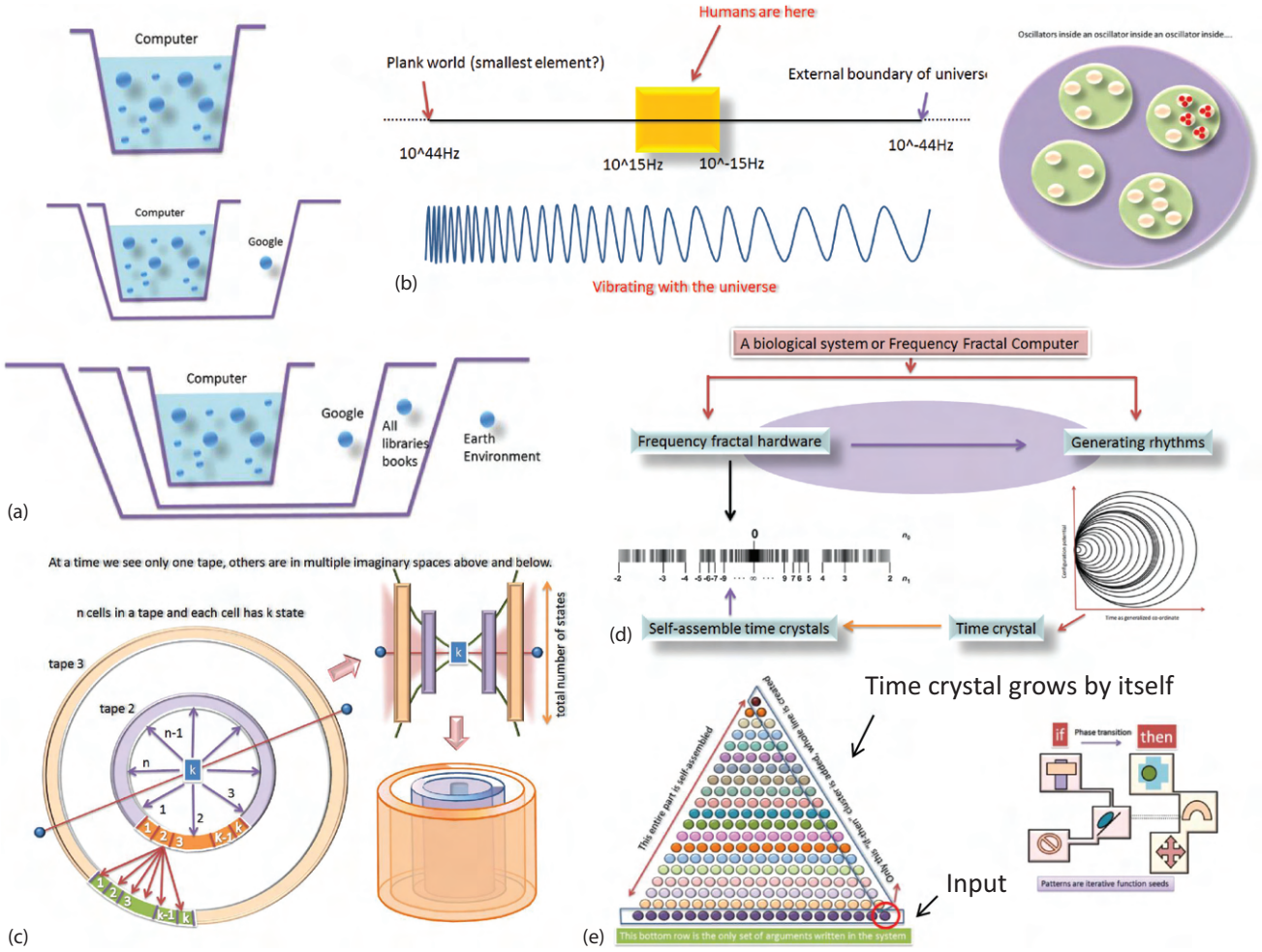

FIGURE 5.1 (a) Gödel's incompleteness theorem is explained in the light of Bertrand Russel's 1 + 1 = 2 argument and debate. (b) "Within and above" concept is explained in terms of the electromagnetic resonance frequency band. The frequency domains are explained as subsets of a set. The extrapolated overview of the universe is schematically presented. (c) Fractal tape concept is demonstrated. (d) Fractal or self-similar resonance band and the nesting of clocks are demonstrated as a key to the artificial brain. (e) Time crystals present a network of geometric structures (corners = singularity points) self-assemble, always the target of self-assembly is to reach one clock.

loops are made of singularity points, which does not accept data or noise from outside (Peirce, 1940). Growth of PPM is primordial to every single entity, from the smallest elementary particles to be found around the Plank length and plank time several millennia from now to the extreme end of the universe, the growth is not natural but metrical, or we could state, as natural as metrical. Growth in the maximum integer of PPM in hardware is also a growth in the time crystal (Figure 5.1e).

From Heisenberg to Gödel via Chaitin: Both Heisenberg and Gödel set the limits and Chaitin connected that to our brain. Heisenberg said, if the time is short, we cannot understand the energy exchange accurately, while Gödel suggested that a consistent formal system that has just crossed the threshold size of doing simple arithmetic is incomplete. Since our brain is an infinite network of clocks operating one inside another, its energy exchange is undefined at all scales. Moreover, since it is also proved that a hierarchical topology is possible to create a system with a few primes 2, 3, 5, 7, 11, and 13, it means the geometric mathematics regulates such a system. Even a tubulin protein-based microtubule nanowire is an incomplete system. Now, Chaitin has put a philosophical argument (Delahaye, 1989), if a finite set of degrees of freedom is given, can we create an indefinite number of outputs from that. In fact, PPM is attached to finite degrees of freedom, it could generate an infinite number of time crystals using a fractal tape (Figure 5.2a). Chaitin's query that argues for establishing that a brain is more than a computer has a unique solution in the PPM perspective. Just like several critical NP-complete problems could be solved by conditioning it (an ant can solve a traveling salesman problem), similarly, here brain=an assembly of finite degrees of freedom is a sufficient condition to trigger the nesting of clocks following the PPM. All objects reside in mind and no object exists apart from the mind (Berkeley, 1959).

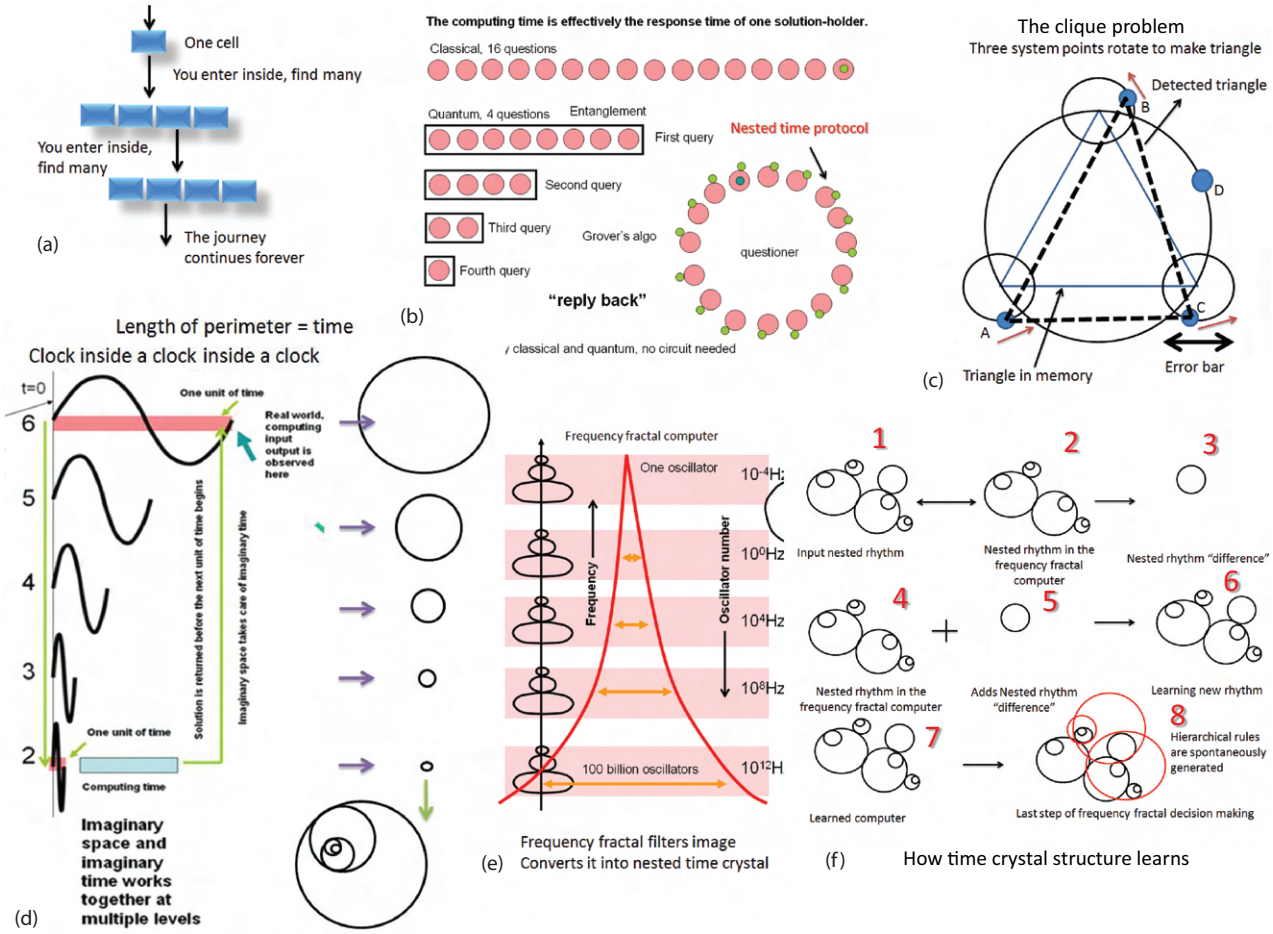

FIGURE 5.2 (a) Fractal tape operation is explained using a diagram, each cell contains a new cell with a large number of cells. An event's statement with four questions (who did it, at which condition did it, what it did, and how it did) is a single cell in this fractal tape. (b) A comparison between classical Turing tape, quantum Turing tape and fractal tape. Clubbing a large number of choices and addressing them as a single question is the ability to resolve a problem in the quantum realm. In the fractal tape, all cells are independent, follows, PPM and since all collectively follow PPM, no need to wire them, all could be communicated at once. (c) Identifying a typical pattern via clique problem is naturally solved by uniquely bypassing the problem using GML, an example is shown here for detecting a triangle. (d) Nested clocks following fractal tape architecture follow a multilayer clock network. At $t = 0$ the problem is encoded as an input at a particular time domain, the problem is sent to network of clocks, one inside another, the geometric relationship resolves the problem in the hierarchy of layers and the problem is solved. (e) The number of clocks used in implementing the fractal network of clocks in the panel (d) is presented in the panel (e). (f) Time crystals, during the learning process identifies the missing geometry of clocks, i.e., it compares naturally missing clocks or could add both time crystals as is.

5.1.1 A Marriage between Frequency Fractal Hardware and the Time Crystal

The eclipse of Newtonian thoughts in the 1960s: The days of scientific certainties were over in the 1960s, Newtonian clock-like universe concept turned out to be an illusion, with more and more examples coming up from nature, like the motion of clouds, the behavior of a flock of birds, etc. The unpredictability is definitely hardware. One of the fundamental requirements of hardware is a feedback of the same system and ability to generate superimposed output, individually looked into the system would provide the same bigger picture. It is not visible in the larger scale simply because the smaller part is cut off by the resolution we set, but how the self-similarity could be encoded as a generic tool, so that anybody could program more and more self-similar patterns are not discovered yet. However, several such patterns have been found starting from Mandelbrot, $Z = Z^2 + C$, how this equation which is called God's own fingerprint interacts between two sides of equality as feedback is the most exciting part of an engineer who wishes to device and engine like God.

> "nature, at some extremely microscopic scale, operates exactly like discrete computer logic." "So I have often made a hypothesis that ultimately physics will not require a mathematical statement, that in the end the machinery will be revealed, and the laws will turn out to be simple, like the checkerboard with all its apparent complexities."
>
> **Feynman (1967)**
> *The Character of Physical Law*.

The hypothesis is further developed by Wolfram, Fredkin, Finkelstein, Minsky, Wheeler, Vichniac, and Margolus.

The discovery of a new kind of linguistic sensor: We build a sensor that rejects the use of Fast Fourier Transform (FFT) and generates time crystal from every single information. Here event = [subject-clause-(verb-adjective)] means, we search for event = [Slowest/static/supreme host-Condition/Key/Initiator-(What is done-how it is done/Fastest)]. We use a device, fourth-circuit element, Hinductor, H; which is a helix made of insulators that stores the charge to tweak the interference of reflected electromagnetic signal from its surface into a dynamic geometric shape made of the null signal, which acts like free magnetic particles. Conventional electronics follow current-voltage characteristics. Newly invented fourth-circuit element H does not exhibit any current-voltage characteristics, but, magnetic flux-charge characteristics. Lack of electron flow forces us not to call electronics, instead of real, what flows is a virtual particle. Since no signal is found in the free particle-like dynamic structures, so, it is said darkly. Such knots of darkness ($E = 0$ in the interfered electromagnetic wave), are not static, behave as free magnetic particles. Using GML if one could map the active and the inactive regions in the 3D spatial structure of interference patterns, or temporal evolution of the free particles, it retrieves a time crystal. We add two additional helical layers, one below and one above to perturb and generate nested clocks like an event = [subject-clause-(verb-adjective)].

Sahu et al. (2013a, 2013b) have shown that proteins, microtubules and several organic and inorganic structures generate the resonance bands, strictly associated with a time crystal where the symmetry of primes is explicitly evident. We derived the required geometric parameters of a helix or vortex to mimicking microtubule or cortical column or neural network in the brain and body. The objective was to replace all 12 brain components, that we studied accurately from human brain model with a circuit made of generic fourth-circuit element Hinductor that would be a universal time crystal generator as required by GML for fusion, extrapolation, reduction, transformation and morphogenesis of geometric shapes by PPM. Thus, by generating the knots of darkness or magnetic particles as a function of charge, we could build nested clocks that follow event = [subject-clause-(verb-adjective)], we realize the fourth-circuit element, Hinductor. One could physically emulate the role of primes or singularity points in a practical device, i.e., a 3D assembly of Hinductor. The marriage between Hinductor and PPM is analogous to the marriage between a Turing tape and a transistor.

5.1.2 PPM Allows Two Systems to Sync without Communication

What is an electromagnetic resonance: Do we promote the idea of electromagnetic resonance alone in this book? Electromagnetic resonance means that if we pump an ac signal, the molecule transmits the ac signal at a particular value, using conventional network analyzer or impedance analyzer one could measure these dielectric properties namely reflectance (S11) and transmittance (S21) and determine the spectrum of ac frequencies at which the values are maximum. Now, if the molecule has multiple embedded symmetries then for each symmetry, we do expect a new distinct frequency that makes it transparent. Several times, multiple peaks appear, shift, get active or silent together, as a result we could build a time crystal architecture. **Does the brain involve in wireless communication across the entire architecture, is it quantum or classical?** The answer is no. A brain does not have a giant antenna-like structure there is no high-powered radiation, transmission. In fact, even if we make the provision for massive power radiation, it will be completely absorbed in the immediate vicinity. The concept of resonance chain suggests that there is a common overlap among the resonance bands among all components that makes the brain jelly or the entire brain architecture. The process ensures band to band transition of energy just like that happens when we add one electron to a molecule, all atoms distribute a part of the electron among themselves.

5.2 THE ORIGIN OF FRACTAL RESOLUTION AND INSTANT REPLY

Scale-free dynamics is an essential outcome of Fractal tape network: It is established for the human brain that logarithm of frequency varies linearly with the logarithm of power expense in the brain. A logarithm is an important mathematical tool that tells us that the order of variation is important in a system, not a linear step-by-step increment. In other words, the parameters would take values 1, 10, 100, 10000, 100000 and the hardware is architectured in such a way that it considers the non-linear increment as the linear variation of 1, 2, 3, 4. The situation originates from a simple design protocol, "one unit communicates with 10 others at every level," or "one-to-many and many-to-one at a time, at every level." One very interesting aspect of this eight-level operation would be that "time to synchronization" or "computing speed" would be the same for all levels of operations, the larger sizes would require fewer complete wave patterns to synchronize; while, the smaller size clusters made of only a few neurons would require significantly large number of waveforms. Eventually, both the processes would finish synchronization at the same time. It is the "clock inside a clock inside a clock" feature that originates from a Fractal tape network in Chapter 2.

5.2.1 Spontaneous Reply—Search without Searching

In classical digital and quantum computing, if we want to find an answer to a question from 16 different persons, an algorithm needs to be written by a software engineer, wiring is necessary to connect components, and the question needs to be asked and processed one by one in classical computing or as a group in quantum computing (Figure 5.2b). In brain jelly computing the question is asked out loud for all to hear and the person with the right answer replies back (spontaneous reply-back). Also, it signifies that we do not have any

wiring to address the switches one by one, which represents a radical shift from the existing world of computing.

Living life is resolving an intractable problem perpetually: Real-world problems are all similar to some classes of intractable problems for which we need solutions at every moment. It could be shown very easily. Suppose, we are passing through the road which is crowdy, we analyze completely different dynamics of every movement and determine the minimum collision paths. It is a traveling salesman problem. But if the path makes a pattern, and we need to detect the path, it would be a Clique problem (Figure 5.2c). When we are arranging books in a bookshelf which has different kinds of boxes and we have different sizes of books, this is famous "bin packing" intractable problem. If a number of shelves are less than 50, with computers we can do but if it is more then we can't, but a geometric artificial brain can do. Satisfiability: one kind of problem we often solve at every moment. Like taking a decision where a set of three arguments are compared with a set of 5 more arguments while 3 more arguments are valid at the same time. It is also an intractable problem and we do it always. Knapsack problem: while sharing biscuits to kids, we optimize often solving this intractable problem. Finally, Clique problem, identifying a typical pattern in a complex pattern is unique pattern recognition that we solve every moment.

The solution of the majority of the intractable problems is associated with constructing the linking between two or more distinct time crystal-clusters. Thus, irrespective of the nature of the intractable problem, the solution is a path connecting several time crystals. Unlike predecessors, the problem is dealt with a pattern of primes, i.e., PPM. The better algorithm means "clever rejection of choices" by minimizing search tasks. PPM uses clock inside a clock inside a clock network, a geometry that runs in the time domain of slower clocks could perform the same task in the faster time domain and solve it (Figure 5.2d). Computer scientists argue that the actual difficulty with the intractable problems is finding the accurate answer, with approximation "intractable" is never a problem. However, here PPM does not approximate solution, the system spontaneously replies back the solution, the system point of the computer does not have to search. For example, in a Clique problem that we target in the PPM computing, wherein, a small 3D pattern is identified in a complex 3D network of patterns, the similar pattern can resonate with the given input pattern as both are encoded in a set of oscillators. It is just like taking a magnet and finding a pin in the pile of the haystack, i.e., search without searching.

Therefore, here PPM has no agenda of bypassing the complexity using hidden approximation protocols. Since several true paths are spontaneously created beforehand and stored in the hardware, or created during computation, automated clustering of time crystals is encoded in the oscillators as a cyclic rhythm since a brain-jelly holds a wide number of problems. Resources increase with faster clocks (Figure 5.2e). Therefore, if we consider isolated single time crystals as rhythms then we have a basic layer of time crystals, at the bottom, then, considering the coupling of a few time crystals, we get another layer just above the bottom level, say, this is the level two. Several of these small-time crystal-clusters couples to form another set of groups, whom we could assign to level three (Figure 5.2f). In this way, several layers of time crystal clusters are formed already during the learning process, much before we attempt to solve a problem. During the search process even if a small part of the already existing path is triggered, however, due to the natural property of synchrony, the entire path gets activated.

5.2.2 Automated Error Correction through Time Crystal Learning

Singularity is not a single point; this is an undefined region. If two clocks with similar embedded time crystals synchronize, their corner points could match anywhere in their common time domain. Thus, the sum of the area of singularity domain is the error correction done by time crystals (Figure 5.2c). In the conventional self-assembly, bonds are made between participating materials, here, either A inserts inside a singularity point of B, or B inserts inside a singularity point of A. Thus, the possibility of error is negligible.

5.2.3 Synchronization of Time Crystals and Incomplete Problems

P or NP, that is the question: Is the debate unnecessary? Is the question tweaking words of the English language? Now, we have passed debating more than a century, "do we need more paper? (intractable, P or NP? P = polynomial, NP = non-polynomial)." If any person can prove P equals NP or it will never be equal then they can get 1 million USD. It is the first time, if we decide "yes," we are the winner, if we say "no" again, we are the winner (Figure 5.3a). Why it is not solved, simply because if we do not know how many more papers are needed (undecidable) then we cannot tell confidently NP could be converted to P or not. If anyone knows how many papers are required to complete the statement then NP = P. From the research of the last hundred years we know that P = NP is several cases (Figure 5.3b). But could there be a mathematical world where P = NP is never true?

If Russel's paradox sets in then we reach a world where P never equals to NP and if it does not, then NP would always be converted into P. Russel's blockade is like many body theorems in physics and we already exist in such a world. Therefore, we have a situation P never equals NP. Then why do we see some cases where P = NP? Those are illusions of nature, we view several fractal arrangements of papers side by side, so it appears as if it is a series of papers glued one after another just as the Turing suggested. Very soon we will argue below that this is never the case. Well, it is a game for the kid, make some sentence that forces us to collect more papers then we are incomplete (Gödel's incompleteness theorem), and if we write a statement so that how many more papers of arguments we need we don't know, we keep it as a variable,

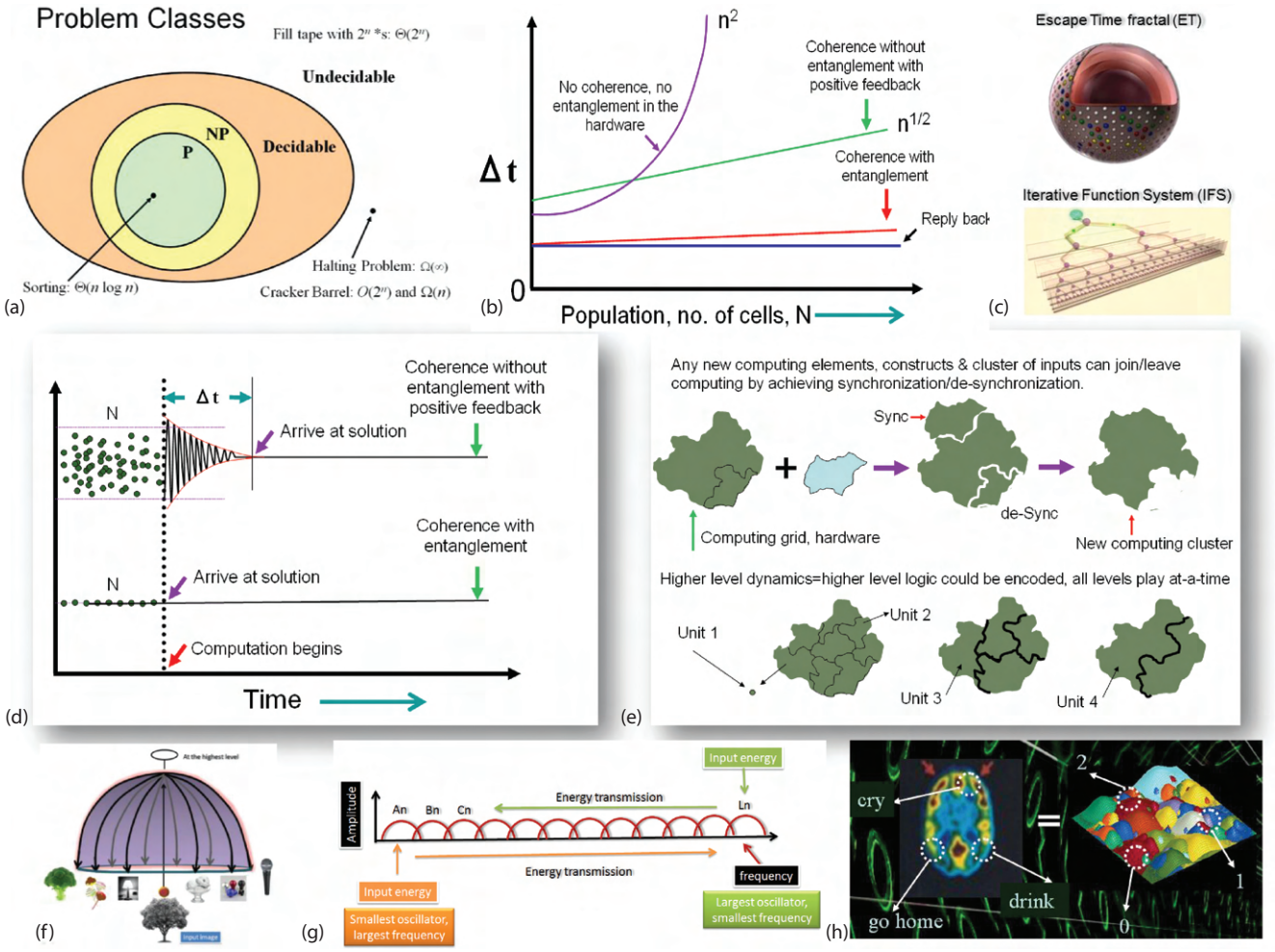

FIGURE 5.3 (a) Different problem classes, P and NP class problems, the intractability of a problem depends on defining a problem, little change in the condition shifts a problem from outside to inside, exchange the cell location. (b) The time taken to solve a problem (vertical axis) is plotted against the population number (horizontal axis) taking part in the solution. (c) Two types of fractals, escape time, where one has to enter inside a cell to find the repeated pattern, and iterative function system, IFS. (d) Two computing types are compared, fractal tape computing (above), where it takes a finite time to make a decision, quantum computing (below) where no time is taken, rather, there is a collapse. (e) Synchronization is a classical process and it links and de-links different time crystal domains during decision-making. A decision is a dodecanion written in the quaternion format that is compatible with the linguistic feature. Different imaginary worlds of a dodecanion exchanging information as a cluster of time crystals. (f) The umbrella concept of perception. If the geometric structures of different sensory systems are similar, or higher-level structures similar the decision-making achieves perception. (g) Resonance chain concept, where different time domains are connected linearly. (h) The fMRI images of the brain could be modeled as a 3D pattern evolving in the time domain (X, Y-axis) where the amplitude of oscillation leads to a higher dimension.

then it is undecidable. It is as simple as this (Figure 5.3c). So, completeness or incompleteness, decidable or undecidable are issues on the necessity of the papers while Russel's paradox is all about cutting a paper into multiple pieces. One example: Bipartite matrix has non-entangled "separable state" subset and entangled state subset, while multi-partite matrix has an additional "partially separable" subset, now, whether mixed states are separable or not, this is itself an NP-hard problem. Synchronization in a nested clock network of a clock inside clock inside a clock… ensures an exponential increase in sync time, because the PPM-GML-H triad acquires geometry in any time domain, syncs or desyncs them in the fastest time scale and finally brings results back in the desired time domain (Figure 5.3d and e).

5.2.4 Umbrella of Perception—Harvesting Infinity and Projecting from Infinity

If there is no classical point-like qubit, how does reality come from? Fractal information theory (FIT) considers that "there is a Turing tape inside every single cell of a Turing tape," this new tape now fails to become a Turing tape. Fractal word is very misleading, since self-similarity is in the PPM (Figure 3.4). Time crystals that spread over multiple imaginary worlds could reside on the cells of a fractal tape. So, the new fractal tape uses a basic information processing unit, a quaternion time crystal connected to each other, a quaternion that represents Turing tape inside a cell. So, we get a projected hyperspace from

the three imaginary worlds, namely "reality sphere" that sphere is the only real thing in the information units time loop architecture. In Chapter 8, we describe that typically designed spirals and vortices generate a 12-hole phase sphere (Figures 8.4i, j and 8.6) that project the reality sphere, which is the real term in a quaternion, octonion and dodecanion. As explained in GML, a time loop has frequencies at certain time gaps to write the geometric shapes, that is the information content and all the three loops are imaginary, does not come from infinity but from the imaginary space. The projection is feedback like an umbrella that takes a pure geometric composition of the present to the future and takes it back (Figure 5.3f). The path that enables it to happen is a resonance chain, that a link of vibrations in the frequency domain (Figure 5.3g). Let's discuss the philosophy of infinity.

Gabriel's paradox: Gabriel suggested a trumpet that looks like a cone but it goes thinner and thinner to infinity, it has an infinite surface area, but when we try to paint it, we would require only a finite amount of paint, drop it from its mouth and it would pass through all the way. **One-to-one correspondence between the Gabriel's paradox and renormalization:** One-to-one correspondence between Gabriel's paradox and nested time cycle synchronization that is designed to replace renormalization, the surface area of the cone is infinity, however, when we put paint to color it, the paint passes through the tunnel and it blocks at the point depending on the density of the paint. The paint for us is the observer's nested time cycle. The resolution of the solution is always the ultimate.

Hilbert's infinite hotel: Hilbert suggested a hotel with an infinite number of rooms. The infinite number of guests could come in, yet there would always be a room available in the hotel. The same event could be represented by a circle, we can take out an infinite number of points from the perimeter of a circle, yet there would be no disjoint in a circle. A circle is finite only when we fix an area.

Dart on a dartboard: Suppose we have a pin, we throw it on the wall wherein a circle is drawn. What is the probability of touching a particular point, given that there is an infinite number of points in that area? If the probability is zero, then, the total probability of hitting the entire circle anywhere is zero, but that cannot happen. We need to consider a very small area, to get out of infinity paradox.

How many numbers between 0 and infinity, Cantor diagonalization: The answer is infinity, that so many numbers are there in between 0 and 1, even 0 and 0.00000000000000000000000001. Now, take any gap between any two rational numbers, we get an infinite number of numbers between them. $\{n\}=\{n^2\}=\ldots=\{n^n\}$

Hyper-Webster is a hypothetical dictionary of infinite space of all possible letters. The idea is the same as numbers, it has 26 chapters of one letter each. Then each of these chapters has 23 paragraphs and so on. Now, if we go on dividing the possibilities are infinite. The exciting part begins now, suppose the first chapter of the dictionary has all possible words beginning with A, then if one removes A, the rest is same as all possible chapters with all possible words. In fact all 23 volumes are self-complete, if we print one of 23, we are done. **One-to-one correspondence between the Hyper-webster dictionary and the generation of multiple spheres:** If there are a large number of observers, of course there are an infinitely large number of observers, therefore a large number of "reality spheres" will be produced and those would merge just like the Hyper-Websters dictionary. All these spheres are distinctly producing, yet they create a singular identity. Imagine thousands of "reality spheres" being produced and all of them simultaneously hold the solution.

Banach-Tarski paradox: It is very interesting now. We create the same dictionary on a sphere. One could write infinite words on the surface in the infinitely available paths on the spherical surface. Even if we start walking from any one point we could travel covering every single point on the spherical surface following, Up, Down, Right, Left, UR, RL, UL and DR. Now, if the lattice on the sphere could be a hexagonal or rectangular, with six and eight neighbors respectively, we could have three and four equivalent roads respectively. There would always be two poles and hence, two identical spheres could be created just from one sphere if we decide to walk on the routes following a given protocol. Whenever there is a case of the real number of points, by Banach-Tarski argument one could create $1=1+1$, when the number of points is infinite. It violates the proof of Bertrand Russell. **One-to-one correspondence between the Banach-Tarski paradox and the measurement in an FIT:** Suppose we have a nested time cycle sphere, or a time crystal, the observer would also be a sphere, it would sync with the paths and generate the connected path and form a "reality sphere" just like the one here. Creation of an identical information replica is its greatness because the solution of a problem is an infinite space.

Apollonius fractal world: On the sphere we can start another journey. Either on the disc surface alone with three circles like the one below, or start with four spheres making a sphere Apollony fractal. In 3D one starts with four spheres each at the vertices of a tetrahedron. An outer imaginary sphere is the boundary cavity that encloses the four spheres. The gaps are filled by subsequent Soddy spheres thus forming a solid object (at infinity). The result is often called an Apollonian sphere packing. The fractal dimension of the 3D Apollonian has been calculated as 2.473946 [M. Borkovec, W. De Paris, and R. Peikert]. Kravchenko Alexei and Mekhontsev Dmitriy have found an attractor that creates the Apollony fractal. It is the union of three functions: $f1(z)=f(z); f2(z)=0.5(-1+si)/f(z); f3(z)=0.5(-1-si)/f(z)$; where z is complex, $s=sqrt(3)$, and $f(z)=3/(1+s-z)-(1+s)/(2+s)$.

Kissing 12 times is enough to send a message, I love you: The largest number of unit circles which can touch a given unit circle is six. For spheres, the maximum number is 12. Newton considered this question long before proof was published in 1874. The maximum number of hyperspheres that can touch another in n dimensions is the so-called kissing number. It is shown that optimality for sphere packing is $n=4$. The history of packing problem is here. One could have

fun by packing a given area with circles here, here in GML one uses spheres to cover a 3D space. There are three imaginary worlds that construct the fundamental unit of information for the geometric brain's information structure. We see above that the three imaginary functions if they are different then they make an imaginary sphere. Though the circle grows with three imaginary worlds, in the Appolony fractal, the sphere grows optimally with four spheres. For an external observer, a sphere always looks like as if it is made of three circles. Thus, the apparent mismatch between the infinity spheres and circles are resolved.

Harnessing infinity in the sphere and modeling the human brain: A rapid continuous change in the brain's physical structure makes brain modeling a fatal task. Oversimplification is something PPM-GML-H triad wants to avoid. For example, conformal mapping of the brain is done on a sphere (Hurdal et al., 1999). The idea is similar to those who want to map the brain in a hypothetical structure, but a prime driven brain does not. The FIT suggests assembling the time cycles on the sphere. Compared to Hurdal suggested conformal flattening (Figure 5.3h) a brain of primes do not change the physical shape of any part of the brain, for the theory, any change in the structure means a change in the information content. We are bound to keep its purity intact, and then integrate tiny pieces of information in it. Above we have discussed that a single sphere holds an infinite number of paths and we could make a singular mathematical structure of the sphere inside representing the entire human brain. Each of the circle with an independent center could represent the time cycle network representing various organs and their biological rhythms. Using such a sphere is beautiful because we get only one unified system to hold infinite possible time cycles. That is a highly generous statement.

5.3 REPLACING FAST FOURIER TRANSFORM BY TIME CRYSTAL TRANSFORM

The culture of harvesting time crystal from a stream of signals is far more advanced than the culture of reading signals as Fast Fourier Transform (Figure 5.4). When time crystal sends a signal out, it builds new wave streams for each system point in the time crystal architecture. Not just that, each stream contains a sequence of waveforms of a very different nature. In the Fourier analysis we look at the frequency peaks. The peaks are not related. In an architecture of clocks, the relative phase differences between the system points are related, the patterns created by a large number of simultaneously propagating waves reveal the projected topology of a time crystal. Figure 5.5a shows three cases of a triplet of clocks. First, three clocks are nested one inside another. Second, the three clocks are one top of another. The third clock is one connected to the outer boundary of another. One could notice that even if the relative diameters change, the output would be significantly different. The three different classes of nesting of time crystals coexist in a real scenario (Figure 5.5b).

5.3.1 Image Processing and Sound Analysis Using a Time Crystal

Fusion and fission of frequency fractals: Mathematically synchronization means, several iterative fractal seeds, i.e., basic geometric shapes that undergo hierarchical integration (Figure 5.5c) get fussed. De-synchronization means several such seeds get disconnected. In the fractal theory three types of fusion and fission of fractal seeds have been developed.

Type I: Suppose we are looking at a tree, then, the entire tree could be made of a square and a rectangle put together as a seed of the fractal and then by copying this geometric shape several times and then by rotating and connecting with it in very different ways, we can reproduce the entire tree. By combining and rotating basic structures, open and close versions of a triangle, square to all polygons including a circle or curve, or straight line, every single structure found in nature could be created.

Type II: From a basic straight line all primary structures like a triangle, square, any type of polygons could be created using a simple fractal relationship. Therefore, the elementary filters for a complex pattern need not be created specially and stored separately in the hardware, a generic frequency fractal generates all possible polygons from a straight line to circle, and all patterns co-exist. Any modification to this fractal stores the nested rhythms in the form of new fractals and again all possible patterns of those newly stored fractals co-exist. Co-existence physically means a change in the F and G co-ordinates of the 2D frequency pattern to create a superposition of all images, just like several traveling paths of electrons around the nucleus generates a diffused orbital perception.

Time crystal transform, TCT	Frequency Fourier transform, FFT
Periodicity in single wave stream	Composition yes, by looping no
Relate parallel streams	Cannot see symmetry similarity
Relative phase for system point identification	System point that governs dynamics cannot be sensed
Modulated & composition of linear stream differ in topology	Cannot find anything beyond a frequency value
Search mechanism for distinct groups of pulses integral part	Never looks for repeating patterns, so no need.
Amplitude, phase, duration, frequency are geometric shape	Sense frequency & amplitude, no temporal geometry
Spontaneously create search modes to find symmetry.	Cannot find what is missing in a captured data
Topological features of fractal mechanics is searched	Hierarchical topology sensing ability with shape change is not feasible
Sense complex argument	Cannot associate events
Dimension of data: 10 D	1 Dimensional data
Parallel channels, simultaneous, instantaneous readings	Cannot sense simultaneously emerging pattern in million channels
Integrates distinct sensors	No universal language, code needed

FIGURE 5.4 Input information is not processed by Fast Fourier Transform, rather, time crystal transform. These two processes are fundamentally different. The difference between the two processes is listed here in the table.

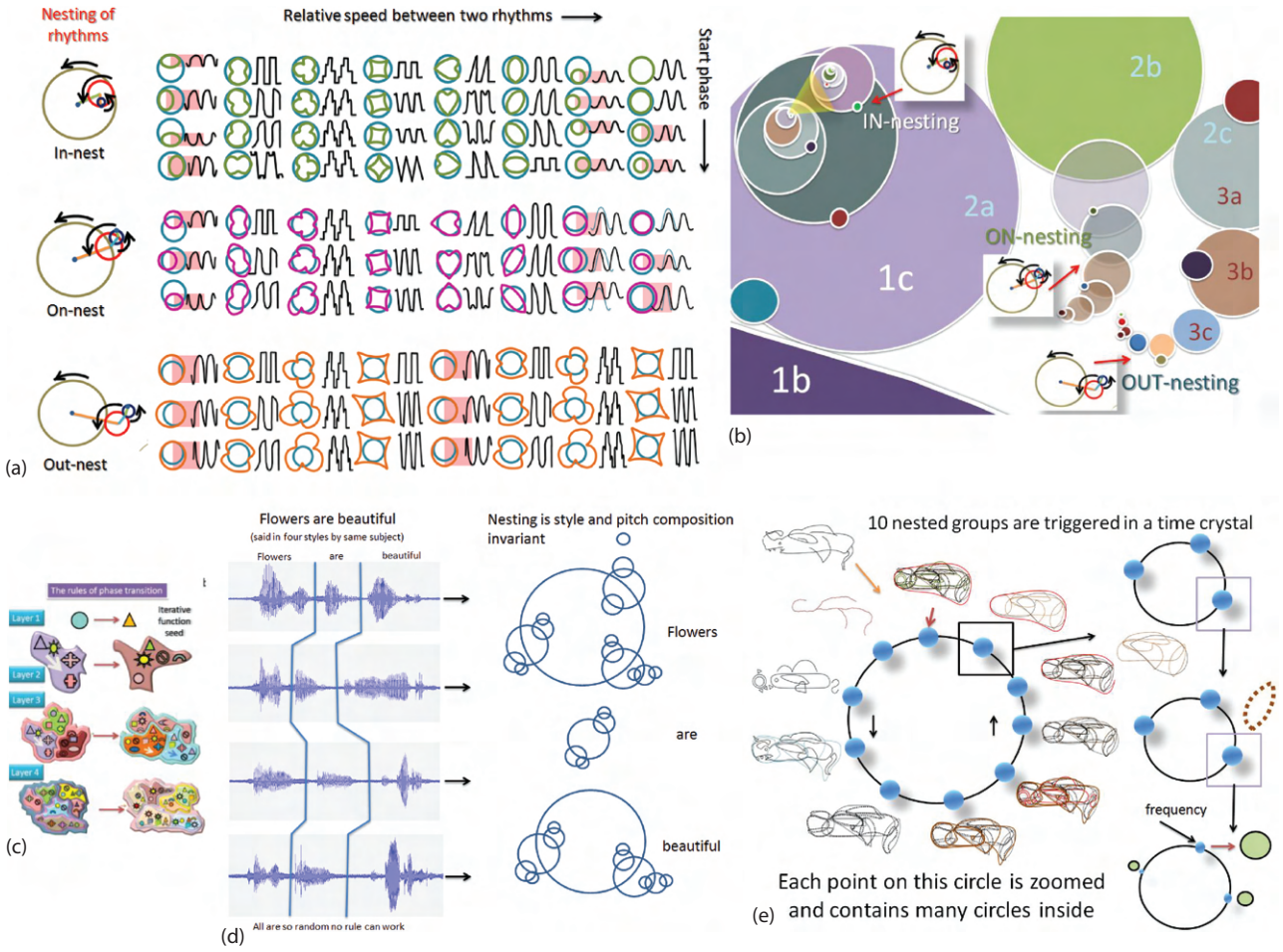

FIGURE 5.5 (a) A triplet of clocks nested in three different ways (in, on and out) are listed here in three rows. (b) Time crystal representation of the in, on, and out assembly of clocks. (c) The geometric shape change is the decision-making, in some cases, it is local change in the geometry, in some cases it is collection of geometries at various layers one above another that undergoes change. (d) Real-time sound data looks very different when you say the three words, "flowers are beautiful." Using an arrow, the words are filtered and isolated. The corresponding time crystals are shown to its right. (e) Image processing is shown by which an image is converted into a set of clocks.

Type III: Several type-I fractals when evolving with time in the 2D frequency space, at the high-frequency layer where we can see the evolution of the frequency fractal A in a large number of pixels, the entire pattern might appear as if it is a simple straight line or curve. Now, at this situation, if another fractal B evolves similarly in the same frequency space with typical common points so that A and B together appears as if a single circle or rectangle, then type II fractal may be born. If AB fractal is born which starts evolving together at all frequency space with AB as their seed, we might get the birth of a new thought that never existed earlier. Similarly, several groups in multiple different regions of the same hardware might spontaneously get coupled just like AB, due to similarities in the dynamic evolution then a higher-level perception fractal is born. These two types of fractals are called type III fractal.

We have discussed two examples. One for sound and the other for visuals, how time crystals are born and hold a nested geometry is shown in the Figure 5.5d and e. In Figure 5.5d, "flowers are beautiful" is said in three different ways, still, the time crystals are identical. Thus, the time crystal language has an inherent universality. Another example of universal information processing by the GML is spontaneously splitting the cartoon elerat, elephant + rat (Figure 5.5e).

5.4 TEN SITUATIONS WHEN THE TURING MACHINE FAILS BUT FRACTAL MACHINES HOLD ON

Turing machine is universal in principle, it emulates only that human emulates, it is now listed what computers cannot do (Hubert, 1972). The 99.99% coverage of all symmetries by a PPM is not complete, but better than corrupting the nature with human bias. Fractal machines are predicted to outperform Turing machines (Dubois and Resconi, 1994). Here in this book we explore the possibilities of hyper-recursive-ness, hyper-incursive-ness, which existing fractal tapes never explored. These big words simply mean nesting of periodicity in multiple imaginary layers. Nesting would endorse the very popular proposals of the fractal holographic brain (Dubois, 1992). Some say there is communication in the quantum

entanglement some says not, some measures even the time required by a quantum state to change (Pfeifer, 1993). We summarize here, how Ghosh et al.'s fractal tape (2014a) could never be emulated by existing Turing tapes, be it classical or quantum.

First, when one converts a set of ratios of the arms of geometric shapes, into a set of geometries using the PPM; a particular pattern repeats (Figure 4.14). This pattern is not the accurate description of the evolving pattern, but a similarity that cannot be described using an algorithm. It is a perception. Imagine a triangle repeats infinite times over the PPM. But, its corner points always have a different geometry, so, there is no rule (Figure 5.6a).

Second, fractal tape machine, FTM follows $e-\pi-\phi$ dynamics, it means electric, magnetic and mechanical resonances follow a particular spiral dynamic. FTM database does not deal with bits or facts, it deals with singularity or confusions. A user finds many confusions, either put them together, or enters inside each one of them and the journey continues, until the user finds facts. Thus, for a single problem, a user would create a few distinct architectures of confusions, whose branches end with facts. Each of this architecture has a

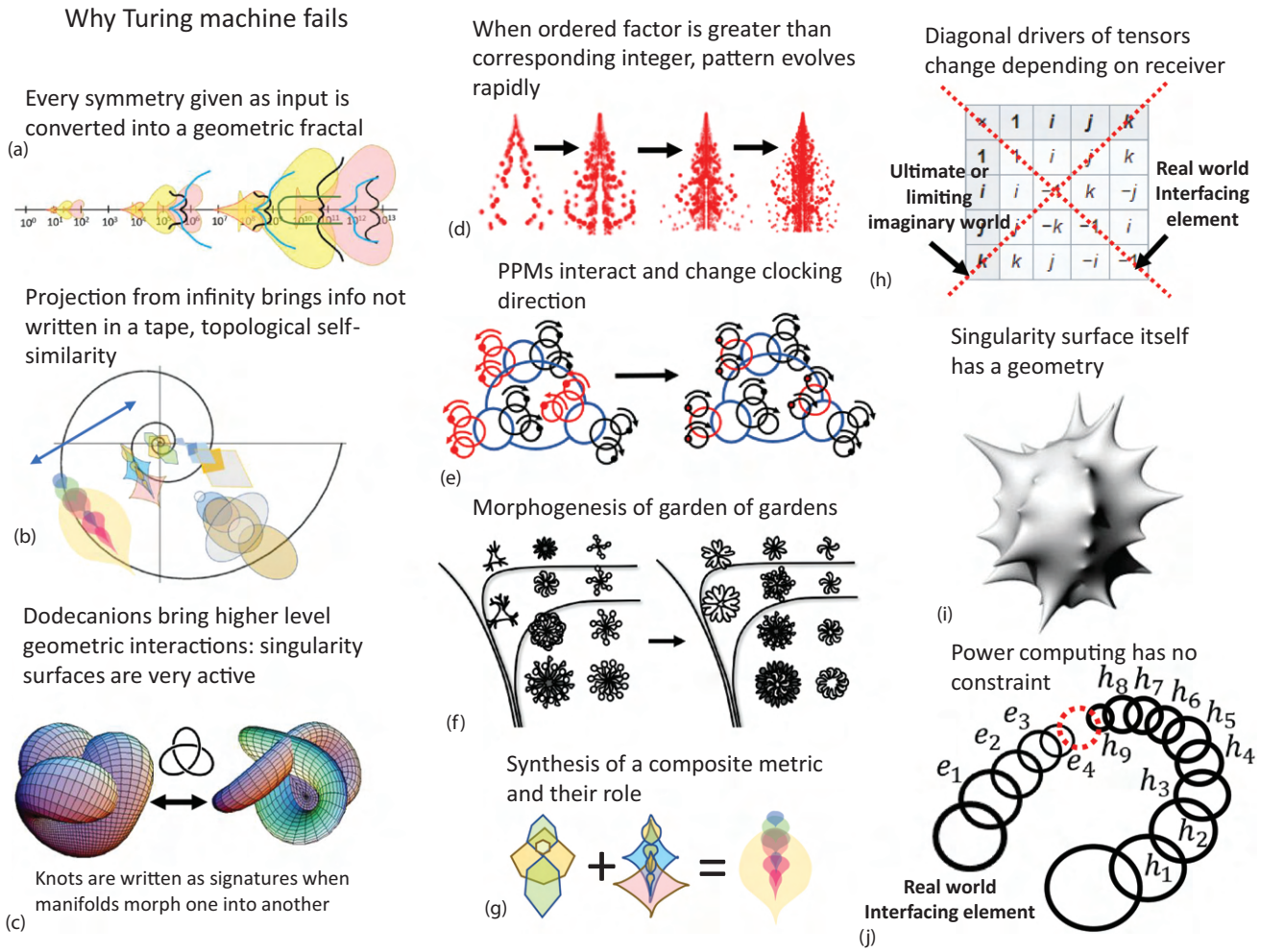

FIGURE 5.6 Ten panels schematically explain why Turing tape cannot simulate a fractal tape that operates based on a PPM. (a) A set of symmetry (not geometric shape made of singularity points, but geometric shape created by broken symmetry conditions) when fed into a PPM changes its shape and starts acquiring complex geometric shapes, no state is defined strictly. (b) e, pi and phi relation bonds several self-similar geometries produced by PPM engine, these are never encoded, but depending on input compositions change. (c) As described in Chapter 2, that dodecanion manifolds are thoughts of artificial brain. Two such manifolds changes are noted to suggest how manifold changes the locations of singularity points. (d) An ordered factor of an integer when greater than the value of the integer itself, the pattern changes are shown in four steps as the integer N increases rapidly from 500 to 500,000. (e) A different set of inputs could build their own distinct PPM, two such distinct PPMs interact, en route making a decision. (f) Garden of garden made of robust time crystals link by isochrones, such networks also activate if the geometric similarities are found. (g) Two activated PPMs could combine and build a new fused metric, that would set the grammar to evolve symmetries as a function of input variables N. (h) Compositions of multinions ranging from 2×2, 4×4, 8×8 to 12×12 matrices have diagonals, each tensor has two orthogonal diagonal drivers, using red lines one extreme real and one extreme imaginary world made drivers are shown. (i) Singularity is undefined, but its boundaries have a topology. (j) Interaction between an octonion and a dodecanion network could bridge events at various temporal junction points, one such path is shown.

distinct PPM and to bond them we put all in a spiral depending on the nature of clocks. This, is again an intractable problem (Figure 5.6b).

Third, in this book we discuss only 12 imaginary worlds operating together, so in the fractal tape, one could enter inside a cell 11 times. The processing of interaction between different imaginary worlds is done with a dodecanion matrix. Now, dodecanion matrix builds a manifold, using a paper and glue, multiple such manifolds are created (Figure 4.13). When a manifold is created, knots are written as signatures. These signatures change due to the interaction of the imaginary worlds. Thus, the morphogenesis of dodecanion metric continues without making any changes in the real world (Figure 5.6c).

Fourth, there is a special kind of PPM, where an ordered factor is greater than the corresponding integer (Figure 3.7). The intricate patterns created on the metric surface never repeats and so fundamentally different than using a common geometric shape we cannot reduce it fractally (Figure 5.6d).

Fifth, the clocking directions do not stabilize, stabilization of a 3D architecture of clocks is temporary. Multiple conditions exist to rotate one clock in opposite directions (Figure 5.6e).

Sixth, Meander flower garden explains a time crystal architecture based self-operating machine (Figure 2.7c–e). Several clocks in a time crystal architecture go silent, for various topological constraints. When it happens, a flower changes from one form to another. When it happens, that particular symmetry is restricted in a system, then, the flowers or distinct time crystals of a meander flower garden undergo major changes. Such morphogenesis of machine is not possible to carry out in a Turing machine, since it happens in the phase space constraints.

Seventh, depending on which numbers are silent in the PPM, the pattern, changes (Figure 3.4). As said, when one tries to solve a practical problem, he finds where the confusion lies and ask quaternion questions (Figure 2.10b) continuously until the architecture of singularity or the architecture of confusion is built. However, each architecture evolves using their distinct metric, since the integers present therein change the metric. Now, when all confusion based metrics are put together into one architecture, there is a fusion of metrics and a new metric is born, that then drives decision-making (Figure 5.6g).

Eighth, if one looks at the tensor diagonal elements for quaternion, octonion and dodecanion (Figure 4.13), they are identical and unique. Note that in a fractal tape machine, FTM, the real world is not fixed, it could be anyone, when the observer sees a world that becomes a reality for it. At a time three observers could see three different worlds; those worlds are reality or diagonal elements for them. Thus, multiple diagonal drivers redefine reality (Figure 5.6h).

Ninth, singularity points are the corners of a geometric shape. Singularity in mathematics is a confusion in the decision-making process of fractal tape computing. The 3D architecture of confusion, is the geometry embedded in the time crystal. Note that entire architecture is a singularity point. A user starts searching for a solution from a singularity point or conceptually a confusion and go inside. Each singularity point has a 3D geometric shape which projects distinct information 360° (Figure 5.6i).

Tenth, two chains of tensor elements could exchange energy and information if they have a common geometric element (Figure 5.6j), such a condition is impossible to meet.

5.5 THE HARDWARE ARCHITECTURE OF AN ARTIFICIAL BRAIN

Figure 5.7 is a summary that outlines a proposed fractal tape machine-based architecture for decision-making. The chart is self-explanatory and we outline the speed of computing, that requires an additional explanation.

What that could never be achieved by increasing the speed incredibly: When a hundred pieces of time crystals interact at a time, no sequential set of events could describe it, or could convert the events in an algorithm format. Therefore, one-to-many at a time interaction is something that could never be achieved by speeding up, and this is what makes any simultaneity based computing model like PPM-GML-H triad unique and far-advanced that the parallel computing.

Majority of computational algorithms developed in the last three decades have considered that the devices that hold the optional solutions of a query could listen to the question but could not reply-back to the questioner simultaneously and spontaneously. Thus, to learn the location for addressing each option specifically, the wiring of computing elements became necessary in the computer chips.

The circuit is a liability even in a quantum computer: The associative matrix. Additionally, we need a program that coordinates the process for a system point to reach to the individuals and retrieve the replies one by one, several protocols are adopted to decrease the computing time. The quantum protocol only decreases the number of queries, with Log_2n advantage over classical, n is the size of the search space, but "reply back" requires an antenna and receiver attached to the memory elements and new kind of the identification code. Grover's algorithm suggests that due to entanglement any number of people in a group could be considered as one object/choice, if any classical route allows such group-test such that classical computing would match the quantum computing. Additionally, except for a few problems (factorization), the quantum protocol does not provide sufficient speedup. The reason for the exponential speedup is the sharing of associative matrix D, which requires a particular requirement in the nature of the problem. Moreover, for pattern search, the matrix D needs to be redefined for each network mode, hence entanglement needs to be broken, which would collapse the speedup. There will be no difference between a classical and a quantum search. The exponential speedup is not the prerogative of quantum entanglement; it could be realized in a purely classical system too (Jozsa and Linden, 2003). "Spontaneous reply back" supersedes the exponential

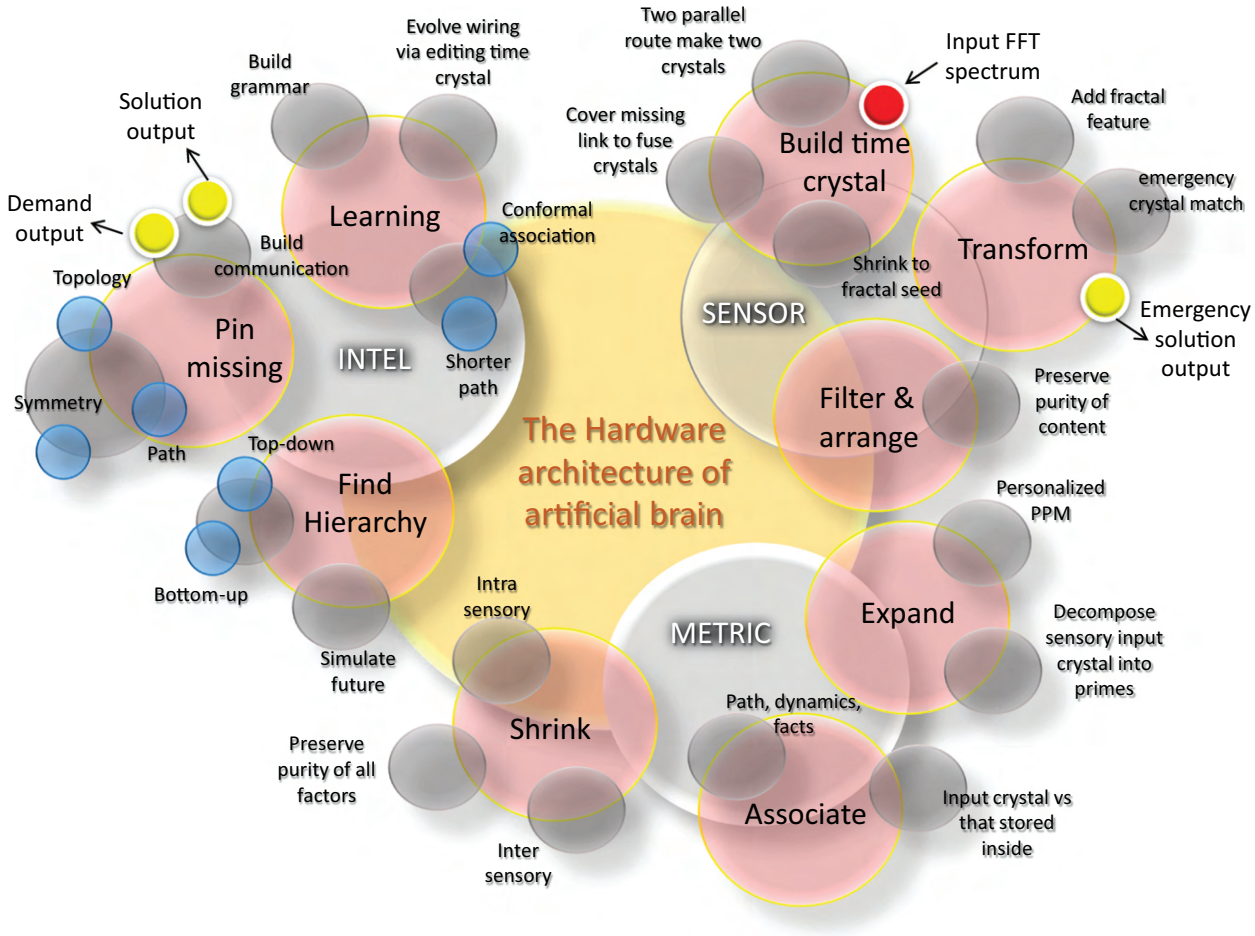

FIGURE 5.7 The hardware architecture of an artificial brain is shown in the pattern of a time crystal, since, instead of an algorithm, the system runs by nested clocks.

speedup promised by a quantum computer, associative matrix D is replaced by locally matched time crystals in a globally time crystal network.

Instead of Log_2n attempts, we want to make only one query, and the solution would reach the questioner, then the size of a search space becomes irrelevant. If we use a multinary switch (with more than two decisions) that has an antenna for each state in addition to the sensor, it can radiate out the solution in all directions, so irrespective of n, the questioner gets the answer in one attempt. Bandyopadhyay and Acharya (2008) have demonstrated this technology. Fundamentally, the basic information processing device will be an oscillator attached to an antenna and a receiver, the oscillator is so designed that we can write/erase multiple resonance states. When an electromagnetic signal is applied to the device, multiple resonant oscillator circuits absorb energies specific to the resonance frequencies and start oscillating. The oscillation turns the system unstable; as a result, the energy is radiated outside via non-radiative coupling, noise does not mix with signals as the absorption occurs only for signals with the perfect matching frequencies, at the same time, the emission is always quantized.

5.6 THERMAL BREATHING BY MICROTUBULE AND ARTIFICIAL BRAIN

The energy applied to produce, process and store time crystal is in the ultra-low energy domain, the devices harness available energy $kT\left(k = \text{Boltzmann's constant}, T = \text{temperature}\right)$ in its environment in the kinetic energy of the surrounding gas or liquid molecules. The energy is transferred by a non-radiative process, therefore, there is no loss during transport, between different parts of the hardware, the processing and storage of information is done at the same place, therefore there is no time loss for retrieving data for processing at the same time, we save a large amount of energy. Information storage is done via rhythms of natural vibrations therefore like the silicon computers, refreshing the switches for every millisecond, is not required. Also, as we have described, a majority of nano sized biomaterials have absorption band in the THz regime (5–6 THz means around room temperature), hence those are not efficient machines at all, they consume huge amount of energy from thermal noise or available energy kT, we calculate only the calorie that we consume, this is not fair. Entire processing in the artificial brain takes place

using the fluctuation of Brownian motion using typical architecture, and/or chemical energy. The computer accepts energy from outside whenever an instruction is required to operate, otherwise it does not use any energy from an external source. Energy is spent through symmetry-transitions and that is governed by speed limits at various scales. Importantly, from the thermal breathing model, if nature only optimizes the speed limits while constructing a system, symmetries are born, and energy is spent only to evolve circuits, it is translated to different simultaneously communicating channels.

Figure 5.8a describes the thermal breathing pathway, where, defects in the ordered lattice transmits through the structure as soliton and several solitons of similar nature and that of different kinds condense. Geometric processing means a change in the shape of a triangle stored by a time crystal by noise, until triangle changes into a different shape, the information content remains intact. Thermal breathing is made of two simultaneously operating engines as shown in Figure 5.8b. Each class of solitons has its own distinct feedback pathways by which they filter out noise and transmit signal. Note that each path has a distinct structural symmetry and an associated dynamic (Figure 5.8c). Sahu et al. (2013a, 2013b) carried out temperature variation of a single microtubule conductivity in the temperature range of 5–300 K. Figure 5.8d shows that the conductivity does not change with the increasing temperature. However, if one zooms the nearly linear variation of conductivity, it shows quantized jumps randomly, yet it maintains the linearity. Another interesting feature is that if one encodes a particular conducting state, then during temperature variation, microtubule holds that state. It means microtubule has broken valence and conduction band, i.e., the edge states are not straight, rather curved and makes contact at various symmetries. As a result when those particular symmetries of microtubule are activated, then, microtubule transmits through particular contacts between the valence and the conduction band (Figure 5.8e).

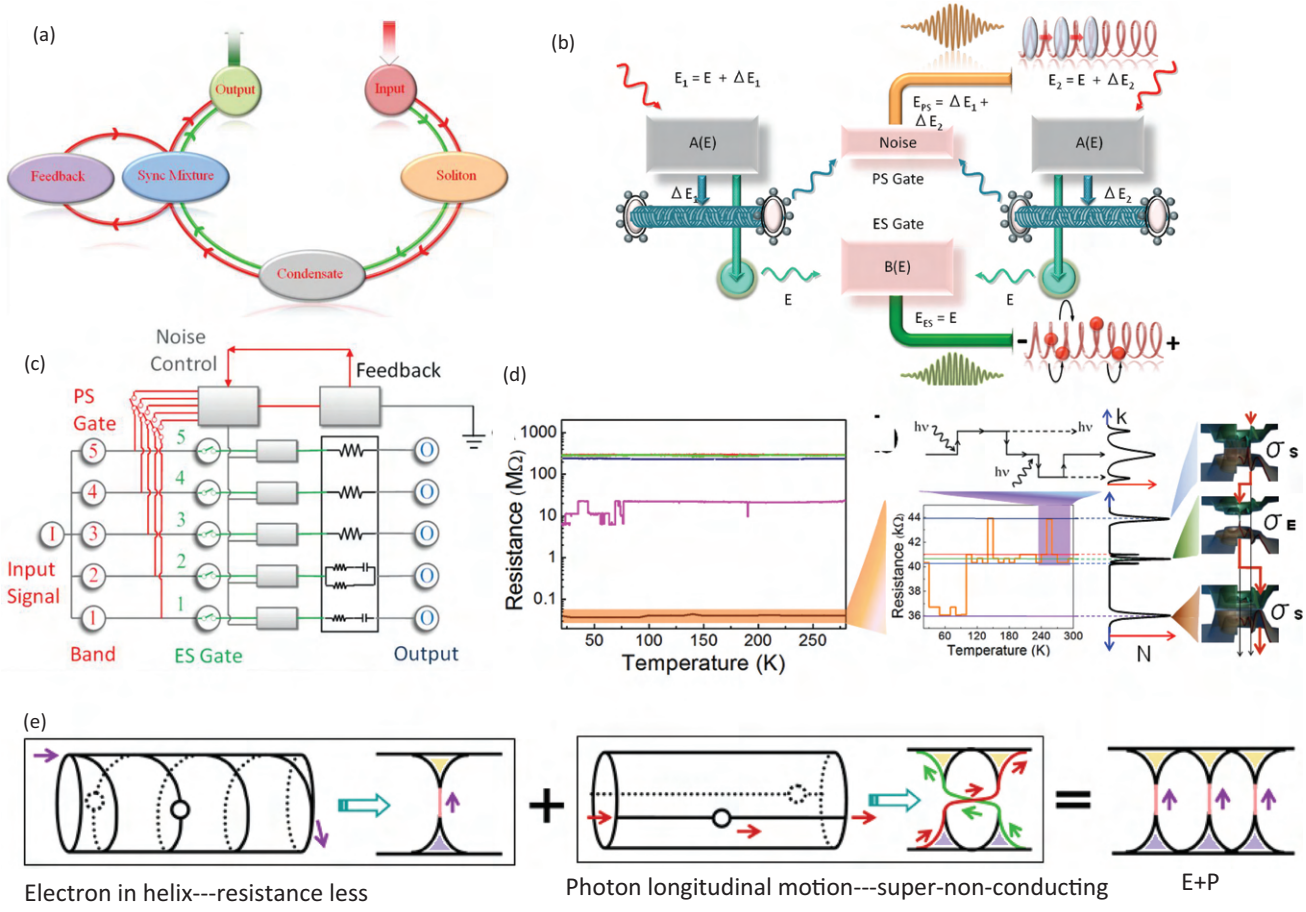

FIGURE 5.8 Thermal noise management of an artificial brain (a) Condensation of soliton pathway between input and output of information processing is shown. (b) Electronic ES and mechanical solitons PS are shown as a composition of two distinct transport routes. Two distinct channels are governed by two distinctly operating engines in the unit device that processes information in the device. (c) PS gates are the first ones that operate when the signals enter in the device. It is followed by electronic quasi-particle operating gates or ES gates. Five channels in series operate in the scheme with a feedback network. (d) The breathing of a single microtubule nanowire is demonstrated. The first plot is the change in conductivity as a function of temperature. A part of the plot is zoomed and it shows that the conductivity changes randomly but in the quantized energy levels. *N* number of point contacts are shown here. (e) When electrons vibrate remaining in the cells of a cylinder along helical path, point contact is shown. To its right phonon paths are shown which creates crossover (red and green). The combined effect is shown to the extreme right.

However, such unique energy management using dual channels is surprising. If there exists any unique and new physics it should exist everywhere, we select brain, since it is compact and its complexity is enormous, an ideal test system to verify rhythms of the spiral symmetries, because the entire universe would also be a spiral symmetry,—singing a song toward completeness.

5.7 LOTUS IN THE PRIMES—REVISITING THERMODYNAMICS OF GEOMETRY

Why entropy and probability came in the information theory: what if there is no communication?

"Information is the resolution of uncertainty," said Shannon. Quantifying information is dealt with information theory. When we copy and paste a file, it is a lossless communication, but mp3 coding is communication with a loss. We do both in our day-to-day operations. Shannon argued information as a purely quantitative measure of a communicating entity. Say, through a tube, we are sending water, now if it is purely random, then there is no effective communication, but if we pump the water, then it moves in a certain direction, but how much water can flow? It depends on how many water molecules we could send in a certain direction. That means from the degree of disordered motions, we are trying to get an ordered behavior. Thus, relate probability and entropy.

The origin of the concept "bits," entropy and channel capacity: Classical information theory, adds all the probability factors to understand the total information, say we have tossed a coin, then, $P = p1\log p1 + p2\log p2 = 1$, so we call it "bits," means one bit of information, and entropy is $\log P$, that is zero. What is the significance of zero? It means the information is transmitted with absolute certainty. Just by saying this we also make sure that the channel passes 1 bit that means in a full capacity, since we have considered all possible choices for tossing a coin, no one can send more information because that does not exist. For the same reason, 1 bit is the minimum bit that is required to send that event through a channel. Or a minimum number of bits required to encode a message without a loss. A basic example of entropy calculation is shown in Figure 5.9a. On a surface with the monolayer of molecules, one has to calculate the number of ordered arrangements, and then, take logarithm, the resultant value is entropy.

Shannon's information channel capacity is not like a water pipe: Here, we deal with an events internal probabilistic structure, not a real channels physical parameter. Hence, it is always decided in the emergence of an event. More is the restriction, or ordering or redundancy,

Fractal Information Theory (FIT): A new way of treating information entropy:

1. Data compression: Encoding always meant finding repetition or redundancy, and then removing them, thus decreasing the P-value. Data shrinking always means finding redundancy. In the FIT we do the same, but with a twist, we do not try to find the redundancy in the physical appearance or an isolated discrete property. We find a natural language of vibrations that is fundamental to nature. Based on that universal language we deconstruct the object and its environment, integrate them in the same language of the time loop and then we also integrate the observer. Then we create an event seed, not the fractal seed of geometric shapes. Even seeds may create a geometric fractal seed, that's not our concern. Thus, change in entropy is not so formal in FIT.
2. Shannon's source coding theorem, data compression: "A lossless data compression scheme cannot compress messages to have, on average, more than one bit of Shannon information per bit of an encoded message." Entropy is a lower limit of lossless data transmission.
3. Huffman coding (1952), data compression: It checks the frequency of occurrence of a particular choice and then assigns a length of memory for passing through channels or processing. It is just like Morse coding; the most frequent choices are assigned a shorter length memory space. Using this route, we can reduce the length of a book drastically compared to assigning equal length memory using each letter as 8-bit memory string. In an FIT, vibrations of the entire book are composed in just one geometric shape, just one, then we go inside the corners of the geometric shape and we get some more geometric shapes. In this way the journey continues, until we reach the singular letter, or fact, but the information is not a resolution of uncertainty. Arithmetic coding is better than Huffman coding.
4. Gödel's incompleteness theorem: If we have a pot then if we want to explain everything kept inside the pot, using the materials within, we cannot. We would need some reference from outside. We need bigger and bigger circles reaching us to infinity. Using the number system theory, we can suggest that incompleteness theory is not complete. Mysticism, religiousness associated with Gödel's incompleteness theorem must be uprooted and thrown out.
5. Escher's paradoxical truth and Huxley's perennial philosophy: We can only get a paradoxical truth. In the PPM, where a different selection of integers creates a new kind of metric (some examples are shown in Figure 3.4). For each of the 12 primes we observed the creation of 37 planes covering 360° in the Figure 3.2c. Each PPM created by a particular architecture of singularity is represented by a particular entropy symmetry plot, if we combine all, we get 3D rotation of all the planes (Figure 5.9a).

Why do we need a new kind of entropy-symmetry plot? The same information is now classified and at any given point of time different classes of information have several distinct features attached to them which are evolving in their own way. We encounter a similar situation whenever we concern

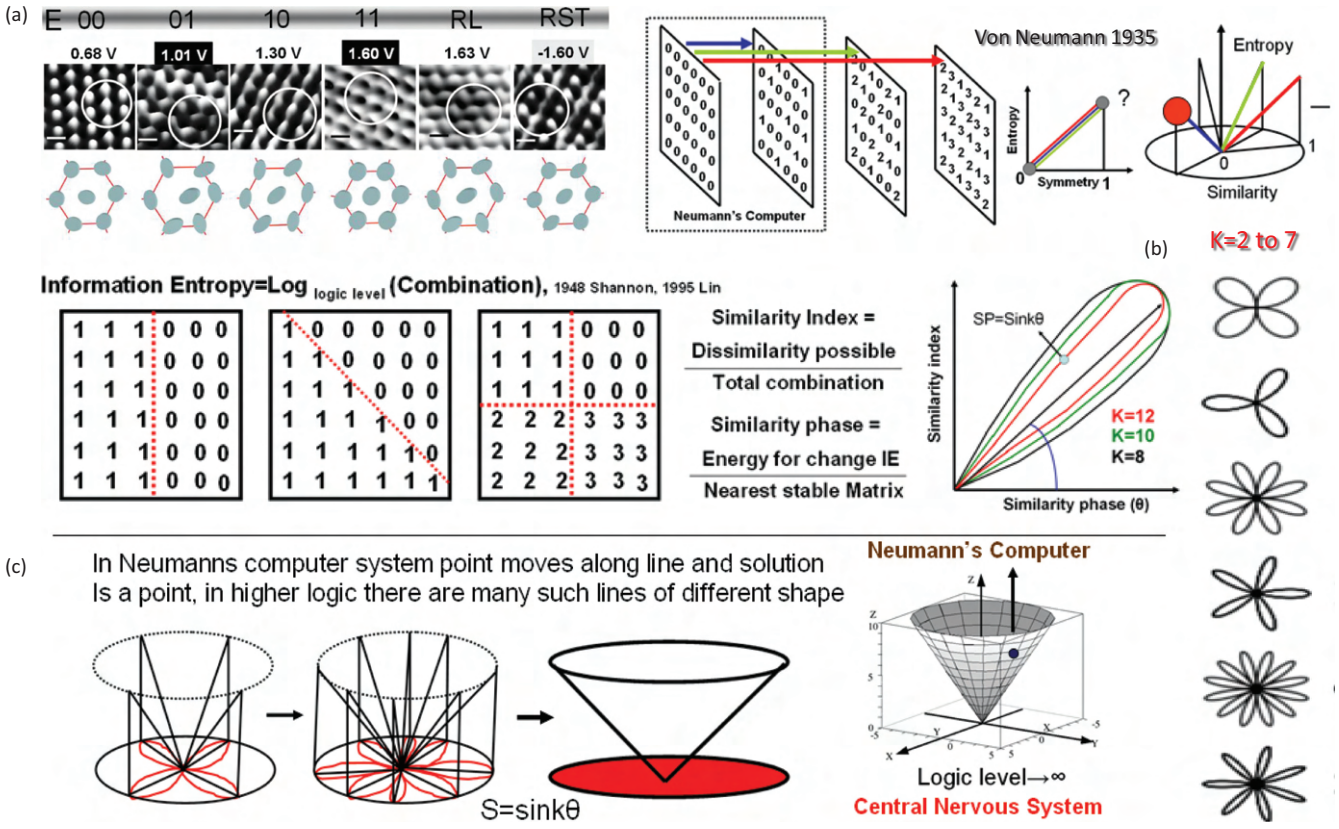

FIGURE 5.9 (a) 2D self-assembly of DDQ molecules which changes basic lattice arrangement for different states of information. The lattice arrangement is shown at the bottom of the panels (top left). To the right, A surface with all identical values has different "1," i.e., information entropy. One triangle needs to be rotated and a base circle is to be plotted. In the lower panel plots multiple 2D symmetries are adopted for which the symmetry-entropy line converts into a flower, similar to the meander flowers of the garden of gardens demonstrated in the Chapter 3. (b) The evolution of meander flowers is shown that replaces entropy-symmetry line. (c) The existing classical and quantum computers form just a single point in the composite 3D flower made patterns of entropy symmetry plot that evolves its flower petals following PPM.

ourselves with the multilayered time crystal architecture. The entropy symmetry expression should be plotted in a new way, one may consider the triangle formed by the linear entropy symmetry plot for a particular time crystal network as an object and rotate it by 360° keeping the zero point as fixed to the ground. The circle created on the ground due to this rotation represents infinite numbers of layers of the cellular automaton or time crystal architecture, and all linear plots of entropy-symmetry constitute a conical surface. In the quaternion, octonion, and dodecanion tensors of Figure 4.13, one could calculate similarity index and similarity phase as described in Figure 5.9a, using that geometric phase variation one could write a generalized petal equation for the universal entropy-symmetry plot (Figure 5.9b). If the number of petals in flower increases beyond length, the entropy symmetry plot converts into a cone (Figure 5.9c).

The entropy-symmetry plot for PPM computer is a conical funnel that changes with time: If we put a marble on this conical surface, it moves and fixes to a place, if we consider this marble as the system point, then it moves through different layers and fixes to a particular point of entropy-symmetry located in a particular floor or layer. It is a very important functional feature of nano brain architecture. Note that as we move to higher layers, the number of cells that constitute the cellular automaton grid decreases, as a result, system point or the marble, carry out a remarkable task of selecting the level intelligence associated with the decision-making of the brain. It is a feature that cannot be realized using normal computational principles, for the reason that higher-level information processing has never been defined in terms of specifically defined parameters. The concept of multilayered cellular automaton and its associated molecular architecture together suggest a new kind of processing where computation is done in a hyperplane constituted by the continuously evolving pattern of symmetries, in sharp contrast to the classical, quantum, or un-conventional computing the information is never addressed directly.

We often wonder why do we need even to know how the universe got created, where is the end of this universe, if there is any. Even when we are studying what happens to the nanoscale system, it appears nonsense why should we learn what happens in a black hole. Limits of a universe can change every single "faith" we have about science. Even simple assumptions that we make could fundamentally redefine

everything. One could generate several worlds of sciences by simply changing the basic assumptions, which we think has no impact on millions of concepts that we regularly encounter. For example, if we think universe has no upper or lower limits, i.e. it is not a closed system, then "conservation of energy," won't work and if we can create the world full of science considering that universe has fixed amount of mass and energy. We must give it a try, how the science would look like if we consider the worldview that the universe is an open system. A nice proposal is that the universe is a fusion of Escape time and Iterative Function System type fractals, where everything is undefined, universe is an architecture of singularity. And then second option to try would be if the universe is a leaking fractal cavity resonator, everything leaks.

What would happen to Lorentz covariance if we reject space, take only time? Lorentz covariance tells us that it means that the laws of physics stay the same for all observers that are moving with respect to one another with a uniform velocity. Motion through space has been the prime concern for the physicists thus far. For us, when we argue to reject "space" from "space-time," keep "time" alone as the singular variable parameter, we also create a version of Lorentz covariance for such a system. That said, it would mean, "the laws of physics would remain the same, when the system point of the observer would match with that of the nested cycle network under measurement."

Information entropy and symmetry: Researchers have studied the dynamic and static information entropy using a ternary molecular switch. The dynamic information exchange is studied in a 1D well showed the closed box features while gaseous diffusion of a dimer, trimer, tetramer on a gold surface showed a typical conical symmetry beyond the classical logarithmic relationship. A general relation between symmetry and entropy is developed for a higher level logic showed the possibility of divisions and creation of a sectional curvature on the symmetry surface. Starting from Shannon's entropy (1948) we have re-visited the debate on Gibb's paradox, in the perspective of the multilevel static and dynamic information exchange process. Furthermore, the universal relationship has also been verified in the organic monolayer consisting of ternary molecular switches. In summery the journey from binary to multilevel information exchange is reviewed in the light of the theoretical development has been made in the last half a century.

Information is a certainty, which is negative of uncertainty; uncertainty is entropy (energetic transformation), therefore entropy measures the lack of information of a system. Here information is a number ranging from 0 to 3 on a surface. In order to reach maximum entropy on a surface all molecules would randomly switch to attain a single logic state at equilibrium. Initially when each molecule is at separate positions with different logic states then they are distinguishable, the surface contains a large amount of information, symmetry is low. However, in later stages when most of the molecules have already switched to the same state then they are indistinguishable, information content decreases, symmetry is high. On a surface if we observe the evolution of information with time, then the entropy asks whether the candidates have the same state or not, therefore the entropy is apparently insensitive to the level of information, i.e. binary and the ternary system would respond similarly. Therefore, we simply count the number of distinct symmetry circuits on the monolayer and take the logarithm of that to get the information content in terms of Nats.

In case of a dimer, trimer, tetramer, considering Lin's evaluation to the Pauling's argument to be valid, we checked the time evolution of symmetry at 77 K on a gold (111) surface. Initially a set of information is given to the set of molecules and the surface is scanned at 0.6 V bias using an STM to check the exchange of logical information thenceforth the matrix. The interesting point between two time frames is that the number of molecules is the same; distribution on the surface is changed to reach an energetic equilibrium. Two isolated quinone molecule of the different charge brought together forming unique dimers of incredible natural features like oscillating in a well periodically, rotating around each other like a binary star, jumping to intelligent positions, etc.

When they form a global network of molecules these features reflect in a unique way. Functional groups of quinone were tuned to find tricks to encode rules inside a molecule that might induce an incredible global transport of information essential for realizing a bio-processor or a parallel computer. The regular structure of CA allows assembly through molecular self-organization, and direct accurate measure of entropy or information contained in it. The small sizes of molecules combined with their availability in Avogadro-scale numbers promise a huge computational power, in which the massive parallelism inherent in CA can be effectively exploited. The distributed nature of CA has prompted comparisons with neural architecture based computers, one could estimate the entropy of a brain from the fMRI images during different kinds of activities, however, that cannot be related with the computation process. Thus, we feel that in the artificial brain, it will be possible to correlate entropy and information accurately, unlike the brain.

Thermodynamics of lotus: How the lotus unfolds and sings the music of cognition (E8 symmetry): Binary switches (0, 1) when replaced by a higher k level molecular switches (0, 1, 2, … k–1) in a quasi-closed system, depending on the number of stable phase or absolute similarity possible, different entropy-symmetry relationship is generated. It generates a 3D surface if k increases, and converges to an analog multi logic system when $k \to \infty$, the surface thermodynamically connects Neumann's computer to the conceptual machine like the central nervous system. Direct experimental evidence for an obvious relationship between information and thermodynamic entropy shows the non-existence of ~100-years-old mystery and myth associated with entropy. The experimental verification of the lotus pattern resembles the E8 symmetry of Lie Algebra. Recently lotus symmetry that encompasses the golden ratio (1.61) has been demonstrated experimentally suggesting that the magnetic resonance frequencies occur as ratios of golden number in the spectrum (Coldea et al., 2010). The E8 group squeezes all states—and local operators—into

representations of the group. And they're quite big. There are not too many singlets (one-dimensional representation that never transforms). The fundamental representation (which is the same as adjoint for this particular group and no other) is 248-dimensional—it's the smallest one that does transform in some non-trivial way. The "next" representation is 3875-dimensional. For a lotus that blooms we get entire series starting from 248, 3875, etc. We do not endorse the theory of everything view on E8 or any singular symmetry, because PPM worldview requires the composition of symmetries and also that depends on which prime point the vortex started to grow. E8 means, the vectors of the root system are in eight-dimensional Euclidean space, for PPM metric as described in 2.6, all Lie group symmetries generate, the lotus is the superposition of all possible symmetry groups.

Historical background: Since 1875, three paradoxes have ruled several fields of physics, chemistry and biology, ranging from the origin of life to the information loss in a black hole. First paradox was Gibbs paradox which was created by equations that contradicted Gibbs law, second paradox was Maxwell's demon, where the role of the demon has always been a suspicious one, the third one is the entropy itself who played a major role in surviving the other two debates as the definition of entropy became a matter of personal choice for the last 130 years. Here, the point of interest is 1955s von Neumanns computer (N) and a million-year-old yet most powerful parallel computation machine (P), our central nervous system (CNS). N process data in terms of 0 and 1, while a neuron burst in a brain is conceptually multilevel (0, 1, 2, 3 … *n*). There might have been a thermodynamic route to connect N with P, and if a generalized expression for k level logic could be developed then for $k \to \infty$ we could thermodynamically connect higher-level processors often observed in nature. Given the fact that processor software deals with information entropy and hardware deals with thermodynamic entropy, we cannot proceed further without solving nearly 50 years old mystery and myth associated with the term entropy.

The second law of thermodynamics, discovered in 1850, said that in a closed system all real physical process would consume energy and the system end up with a less amount than the starting energy. In 1865 when Clausius noticed that in an ideal gas mix, the ratio of heat exchanged to the absolute temperature is constant, he named it "entropy." In 1875 Gibbs showed that when all gas molecules have the same temperature, heat exchange is zero, therefore entropy is zero. If we plot entropy with similarity then entropy remains constant till all molecules come to the same state, then suddenly it falls to zero. Many equations contradicted this relation, and Gibbs paradox was born. It survived for more than 120 years because of two reasons; different kind of entropy came into being and still their relationship is not clear, secondly some of the very basic assumptions were not properly changed when different real situations were considered. Now considering old definitions of entropy and impossibility of the existence of pure gas, it has been shown that Gibbs paradox does not exist at all. However, entropy does not remain constant always, it depends on relative fraction of the mixed gases and therefore the only minimum and maximum entropy remains same as Gibb's while variation in between two extremes depends on the system.

In late 1940, von Neumann and Shannon introduced information in entropy. More information is a certainty, certainty is negative of uncertainty, uncertainty is a disorder, and more disorder involves more energy exchange to reach an equilibrium that is more entropy. Obviously, the new information entropy (IE), negative of information is simply a number and different from the old entropy which is basically thermodynamic entropy (TE). Several hundreds of attempts have been made to correlate this two, separating them, joining them, even challenging the Gibbs paradox or misinterpreting the second law of thermodynamics to reach a conclusion. Mystery and myth about the origin of life have added to this hundred-year-old debate on real entropy as it continued for the Gibbs paradox case. Both schools of thought are well investigated in a plethora of models and systems, therefore following them classically might lead to the truth, but unless the philosophical ground for IE and TE is very clear, following the paths would be misleading.

The journey of negative entropy and information: The breaking adds one phrase to the second law of thermodynamics, that is, the increase in entropy is not continuous, sometimes it may remain constant and sometimes even may decrease, it is a very discrete and random behavior, on global scale entropy increases continuously. It is still a debate where life form or the emergence of intelligence always feeds on negative entropy (Von Stockar and Liu, 1999). Since information corresponds to a negative term in total entropy of the system (Brillouin, 1953), it could easily be modeled to add complexity in a system (Packel and Traub, 1987). However, these formulations have a singular view that the weight of entropy allowed to judge the suitability of a proper computational algorithm in a given scenario rejecting several major aspects, since homogeneous entropy increment concept is broken as said above, the whole idea comes under suspicion, maximum information co-efficient concept is an idea to resolve this problem via considering the specific features of an information (Reshef et al., 2011). The situation becomes very interesting in a quantum scenario, partial information content due to entanglement depends on the sign, positive or negative, and that could redefine the information in the sender and the receiver (Horodeck, 2005).

Basic concepts of information and symmetry: Information or similarity of a system is asked only at a particular time; therefore, it is a static state, count-number associated with the state of the elements provides the IE. However literally the word dynamic at a particular time does not make any sense and therefore any change occurring between two points of time is essential to express a dynamic behavior. Literature is full of contradictory relationships between symmetry and similarity. Similarity means alike in a certain parameter at a particular time, symmetry is the *sameness measure*, therefore in a static system symmetry=similarity. However, more dynamic is the system, more elements can some to the same state, similarity increases or decreases at any given time, but that does not measure *sameness*. The statistical average of similarity within a period of time would be the *sameness measure* or

symmetry. Therefore, more dynamic=more symmetry. It is a direct and clear relationship used in this letter; any readers can calculate it for their own system.

The next point in which literature is full of confusion about the parts should be taken into account for the understanding of entropy of the system. Studying collisions of molecules should not involve vibrations of bonds just to provide explanations. It is well conceived that similar things repulse and opposites attract, but only that part of the system contributes, which has a significant effect on the length scale the entropy is measured. A similar charge, spin, mass, dipole, repulse when system elements are less than a critical distance but if they are not then they attract, therefore ignoring length scale it is very easy to survive entropy debate and often challenging the second law of thermodynamics. The system elements at less than the critical distance and far beyond cases would be considered by making a clear line of difference. At less than the critical distance more is the number of similar elements more is the sum of repulsive interaction energy, therefore more is the TE (TE=energy exchanged/absolute temperature). If statistically there is a high probability that the system elements always interact coming closer than the critical distance, then the above relationship is valid otherwise not. Interestingly, more is the similar elements in a system, it requires fewer numbers to express the information content, therefore when TE increases IE should decrease (IE = logarithm of apparent symmetry number). The simple logic shows the non-existence of entropy paradox; because both existing concepts are valid, contradictory results originate from opposite assumptions. Therefore, if proved experimentally then it would negate the existence of several hundreds of models developed to challenge one another in a different perspective. A simple and careful experiment has been carried out using molecules by Bandyopadhyay et al. in the brain jelly to check the validity of entropy debate in light of the above conclusions (Chapter 9).

In principle, since a system cannot return to the initial state of conformation or information in a closed environment and an ideal closed system cannot be built, therefore a pseudo-closed system is used and the evolution of two kinds of entropy with time is investigated. A pseudo closed system means external energy exchange should be less than the threshold energy for the inter-state switching so that there is no external interference during the energy and information exchange process.

If there is a change in the logic state, change in momentum and finally after repulsion a change in the direction occurs, then there must have been an effective energy exchange. TE is calculated theoretically analyzing the Scanning tunneling microscope (STM) images, and Density Functional Theoretical (DFT) computation, and IE is calculated simply from the logic state derived from STM measurements.

Gibb's relation and beyond: In the similarity vs thermodynamic entropy plot, nearly a linear relationship holds between them while for information entropy (IE), the relationship was linear but 90° out of phase. Therefore, a relationship is established between two different entropies of a particular system; however, most surprisingly this information entropy relationship was also obtained by Lin et al. but unfortunately, they have claimed that their relationship is the real entropy-symmetry relationship and Gibbs relation or modified Gibbs relation are both wrong. Above findings show that similar to Lin et al. hundreds of models which made serious attempt to evaluate the authentic entropy-symmetry relationship needs to be re-examined as the question of right and wrong does not arise at all. Once it is established that similar to Gibbs paradox, no debate should exist for the entropy too, the ground is set to re-visit the thermodynamic aspects of the computation process in a machine like a human brain. Furthermore, in order to connect Neumann's perspective with the central nervous system, CNS, a clear vision of a solution point is the necessity, and unless it is known how these two entropies are related for a particular system the solution point would have been a vague concept.

At this point, a clarification is needed for the solution point. In Gibbs relation, the particles have two phases, distinguishable and indistinguishable. Inside a Pentium processor, the 2D surface of the hardware has billions of switches, during operation or even when it reaches a solution then the hardware surface is a matrix assigning each element or components either 0 or 1. Therefore, when all the switches are zero or one then the system is distinguishable otherwise indistinguishable. Now, for any other combination of 0 and 1 in a 2D matrix, thermodynamically there is energy exchange between switches in the hardware therefore we have a TE, and if we consider only the number, then it is easy to determine how far the matrix from absolute indistinguishability is IE. Therefore, the processor acquires a co-ordinate on the straight line of an entropy-symmetry plot, which could also be the solution of a problem. The reason is that at any given point of time the generalized path of the system point in the generalized co-ordinate would be the solution of the problem. It is the thermodynamic interpretation of the Neumann's computer proposed in 1955.

It is possible to perform validity check experiments on the second law of thermodynamics in the universe where there is no reality. It is not possible to build an absolute close system, and the virtually closed system could be made by a proper choice of the inherent property of the system elements. Modification of the Gibbs paradox by Neumann's is justified, Lin's philosophy is experimentally verified but his challenge to the Neumann's is unjustified as both of them consider different entropies. Neumann investigates information entropy = (−) similarity = (−) repulsion = (−) thermodynamic entropy which Lin considers. During the experimental justification of Lin's proposal, in the brain jelly, multilevel repulsion was observed among different imaginary worlds. During the information exchange process this gives rise to multilevel phase evolution, a basis for a multilevel computer. Multiple phase evolution in a single experiment demands a 3D plot, which for $n \to \infty$ becomes the representative of a central nervous system. It looks like a lotus flower. We complete a journey from meander flower to a lotus flower. The motion of any point on this entropy symmetry surface is the thought-like information exchange process in a central nervous system, might be in an artificial brain if the equivalent hardware is ever developed in the future (Chapter 9).

5.8 HOW GEOMETRIC SIMILARITY BUILDS CREATIVITY IN COMPUTING PRIMES

First, seeing a typical tree when we resemble it with the dancing girl, or balloon looks like a lozenge, there is no formal logic. Such familiarities are creative and go beyond algorithmic logic (Figure 5.10a).

Second, the integrated geometries of different kinds of data may look similar. For example, the relativity and the painting tricks are similar in geometry, but have no relation in concept, yet they could fuse affecting each other, wherever the local geometric matching is there in the respective time crystals (Figure 5.10b).

Third, even within a very particular type of data, like the advent of diabetes among masses, we could have totally uncorrelated functions and symmetries in the statistical distribution. However, if local distributions match geometrically, then, they would build a fractal geometric seed together by combining the geometric seeds (Figure 5.10c).

Fourth, when a fractal tape machine searches for a geometric shape, it can make a mistake. That error is corrected when

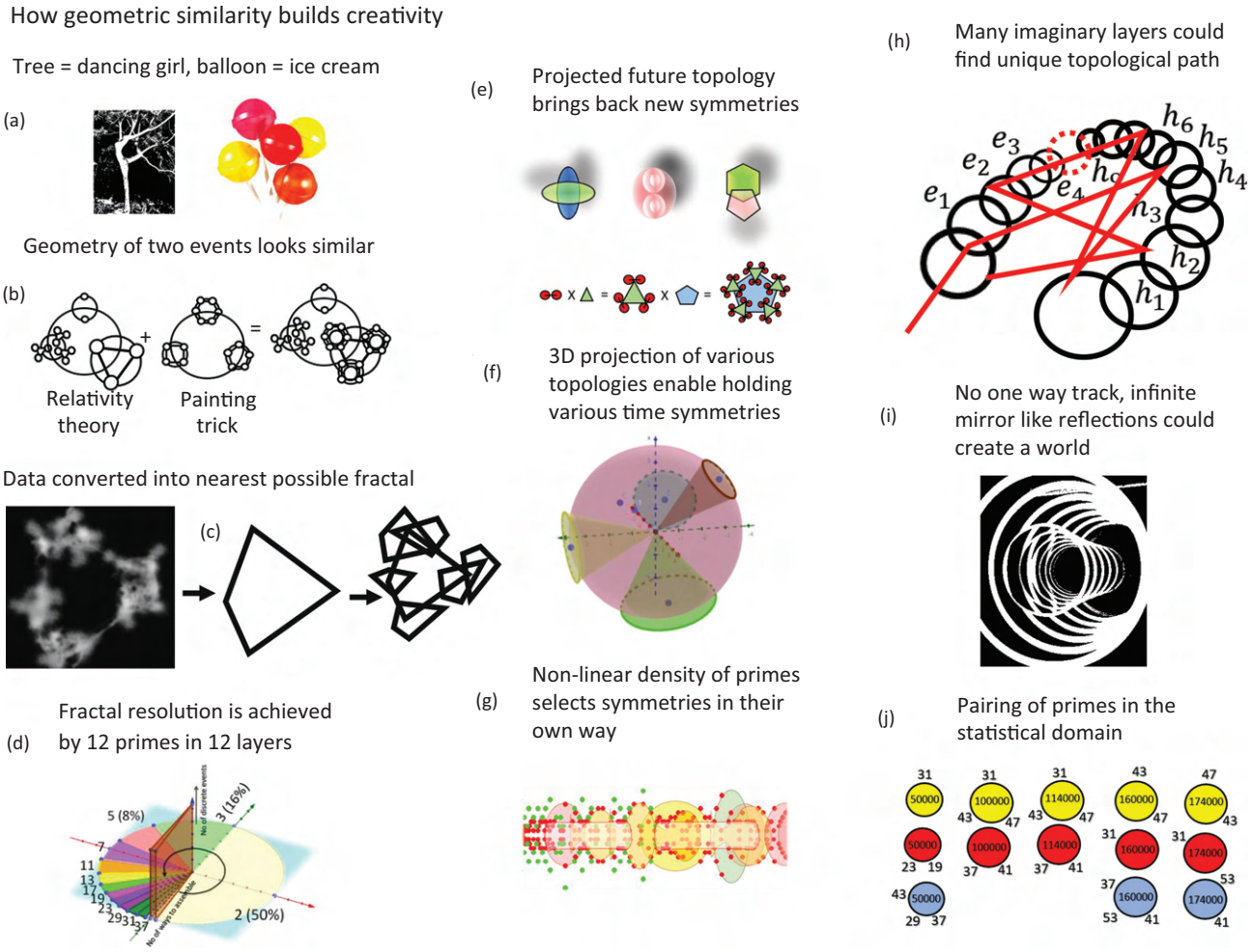

FIGURE 5.10 Ten different ways of building intelligence and perception in the artificial brain. (a) Geometric self-similarity among fundamentally different sensory outputs which have no contextual relation. (b) Time crystals of totally unrelated events, if appear similar, they undergo morphogenesis. (c) Self-similar geometric features are adopted as a fractal since time crystal binds repeating events in a single loop. (d) Fractal resolution is a unique concept, where a particular data achieves a better resolution as it enters within, 12 imaginary layers engage in perfecting a particular data. (e) PPMs have unique projection, that projection is fed to the system back which changes the singularity built geometries. (f) The information encoded as time crystal has a unique projection around 360 degrees. (g) Non-linear distribution of prime density selects input set of primes or input information as they sense it, so it is not a homogeneous acquisition of information. (h) Co-existence of topological paths that links different imaginary worlds within a multinion or across a multinion (e.g., octonion and a dodecanion) could lead to the birth of a new unexpected imaginary world. (i) PPM is not one-way traffic, it has many pair of mirrors generating infinite reflections between them. Thus, multi-modal mirroring could generate a new kind of information processing. (j) The pairing of primes, silent primes in the statistical distribution of primes in the integer space is another prime factor that regulates output.

the 3D geometry hidden in the singularity domain is searched and properly mapped. A similar error correction runs for the 12 layers (Figure 5.10d).

Fifth, when the symmetries of the randomly obtained geometric shapes from the events happening around nature are compiled and the corresponding PPM is built, similar geometric shapes are found to repeat over the integer space. The projected geometric shape means finding visually connected, irrespective of conceptually non-connected features. Thus, it is not logical (Figure 5.10e).

Sixth, a time crystal architecture holding the entire information could project different temporal patterns at different solid angles, all around it (Figure 5.10f).

Seventh, PPM have three-tier control on the evolution of a time crystal or the information architecture (Figure 3.16). First, the sensory layer, where the ordered factor metric or OF metric acts in converting the sensory data. Above this layer, a hierarchical control on the lower level metrics is made by a prime composition metric or PC metric. Above that there is a prime gap metric or PG metric that looks into the symmetry of the primes used. Three layers, operate together, one above another. The symmetry of symmetries of symmetries is beyond logical predictions (Figure 5.10g).

Eighth, in reality, the elements of quaternion, octonion and dodecanion or icosanion are time crystals. The elements of icosanion tensor could be a dodecanion, the elements of a dodecanion tensor could be an octonion and those octonions would have quaternion elements. Thus, the nested time crystal elements could build distinct geometric pathways which could connect in the time domain (Figure 5.10h).

Ninth, one of the finest features of a coupled feedback network-facing each other is that they work like two mirrors facing each other for the geometric information. While reflecting back and forth, the geometric information could build up architecture by interaction (Figure 5.10i).

Tenth, primes, because of their own distinct feature are silent when statistically one measures the contribution of a prime in a given database of integers (Figure 3.8g). The transition of a prime from silent to a dominant contributor is not linear as the number of integer increases, the relative ups and downs of the ranking of most dominating primes in a given dataset are oscillatory, and geometric (Figure 5.10j).

5.9 THE WHEEL OF INTELLIGENCE—DIFFERENCE FROM HUMANS

Will this be a universal computing machine? A computation is universal if it can emulate any other computation. Emulating a particular computation C means that we can feed a certain code into our universal computation U that will cause U to produce the same input-output behavior as (Zwirn and Delahaye, 2013). Brain jelly is a PPM synthesizer, specific to the input time crystal, if we want to execute generalized computing in this material (Chapter 9). Therefore, if a programmable matter say brain jelly is designed and synthesized to exhibit a large part of the frequency band for electric, magnetic, and mechanical resonance, then, it can emulate part of the rhythms, irrespective of its limitless possibilities, those are bounded by certain repetitive rules. Of course, we do admit that even then, mathematically it could be proved that an absolute universality cannot be achieved.

The ability to replicate all possible rhythms is not just enough for universal computing: The objective of PPM based non-computation is to use minimum resource yet reaching the solution faster than the natural system using nested rhythms just like an avalanche (Figure 5.11). If the advent of cancer disease takes 120 years to reach to a metastasis state, it would be wise to use a replica of nested rhythms for cancer at shorter time scale so that we can predict it within a few minutes. It means ultra-fast events need to be lengthened and ultra-slow events need to be shortened in the time scale to perform a meaningful computing or emulation. **Make ultra-fast events slow and slow events fast:** Normally, if a natural computer is able to replicate a natural event by increasing its speed by 10^{16} times, or by decreasing its speed by 10^{16} times, we can cover the majority of natural phenomena that evolves in our known universe. That means de facto the proposed non-computer nanobrain would be a universal one. For example, we shall always try to predict supernovae explosion in a few months, since it takes billions of years for a star to become supernovae. Whereas, the artificial natural event that would construct the time crystal for a single electron tunneling event should capture it in the femtosecond or picosecond time scale, but then by fractal feature, clock it in seconds or hours. Self-similar feature of the time crystal would bring femtosecond event to seconds so that we can observe the evolution of ultra-fast event in the classical time-domain and analyze how it evolves with time. Two experimental verifications are explained in Chapter 4. So, we expect organic nanobrain to study several animal dynamics by itself, learn and then suggest a particular jelly architecture that would exhibit the necessary mobility features in the real world just like the humans do (Figure 5.12). Afterward, the machine would choose a set of PPMs need to be incorporated into the brain of that robot, and suggest a pattern-evolving grid, finally suggest the necessary rhythm composition rules for that grid. Events occurring in nature are not random. Random events integrate from one singular metric. That metric is closely related to the vibrations of dielectric resonators (Lauber et al., 1994; Pistolesi and Manini, 2000; Pechal et al., 2012; Lee et al., 2011; Joshi and Xiao, 2006). The other criterion is the space constraint. We cannot use the entire mass or all components in a brain jelly to emulate the replica of a nested rhythm or time crystal, the entire process needs to be generated among the cluster of a few participants. Therefore, universal computing using PPM machine demands both spatial and temporal resource management as outlined in Figure 5.11.

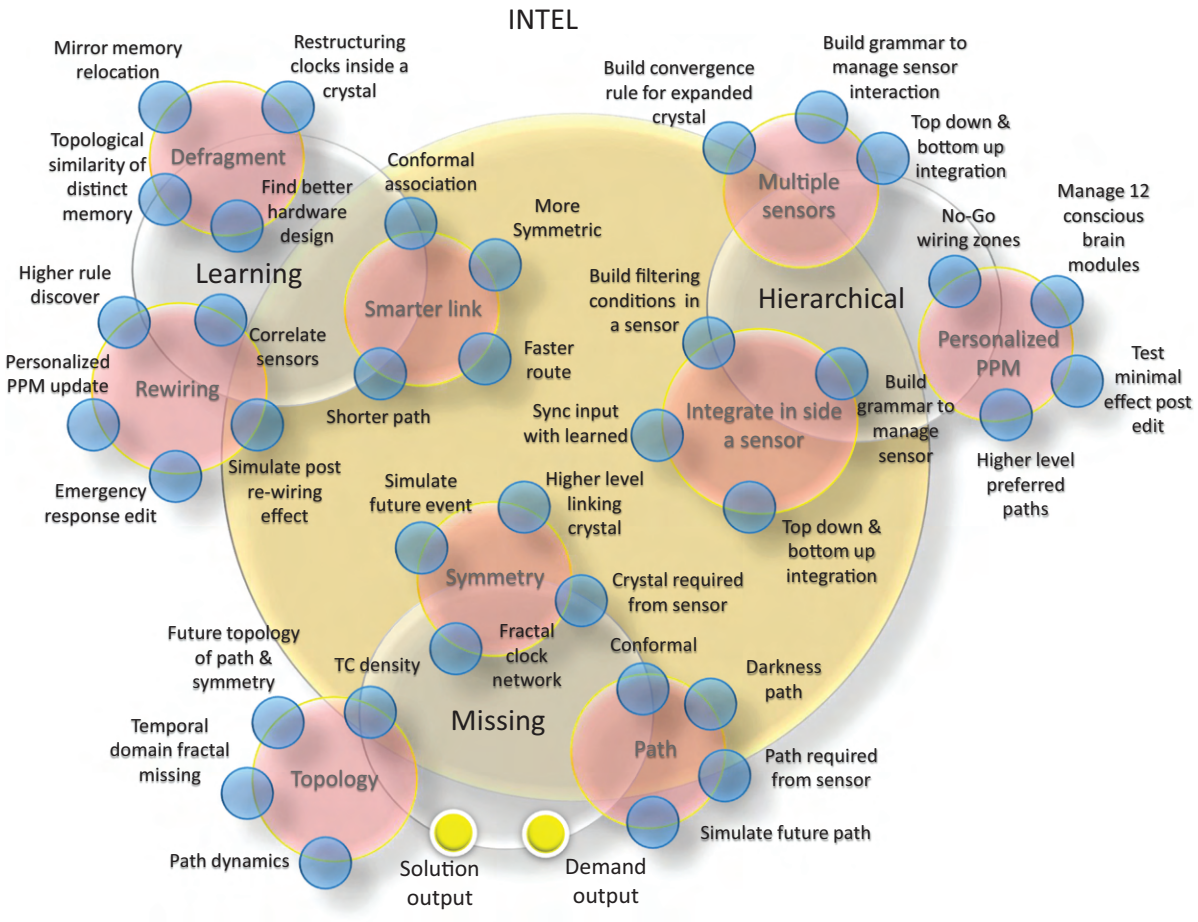

FIGURE 5.11 Time crystal representation of intelligence in the artificial brain. Time crystal always builds between two primes, so larger is the difference between two primes, larger is the complexity of time crystals. Within 1 billion we have roughly 255 million primes means around same number of time crystals. $x/\ln x$ where x is the number less than which the prime numbers should be and $\ln x$ is logarithm of x to base e. So using this, we get 255.88 million. These primes govern birth of creativity and unpredictable situations.

PPM hardware	Human apparent notion
Integrates events, estimates all symmetries, predicts future	Integrates events, estimates few key symmetries, predicts future.
Input is a geometric language, represented as symmetry	Input is a trained language, not derived from protein vibrations, e.g., english
10D data structure	4D data structure
Density of primes & ordered factor of symmetries considered	Finite symmetries, few anomalies of primes consider, varies among humans.
Do not care observation, linking of events are mathematical	Emotion, culture etc various temporary & long term biases, shift links.
Future prediction is instantaneous but accurate	Instantaneous but partially accurate.
Superposition of possibilities are mathematical, infinite.	Superposition of possibilities are driven by temporary information processing ability
One PPM chain needs to be used millions of times at different spatial & temporal scales to build a humanlike architecture.	By common notion (human = turing machine), all human information could be written as 0 and 1 in a single one line tape
To replicate in device, one element has to work as many clocks, part of many time crystal	By common notion (human =turing machine) one device = one work.
No integer except primes represents a single geometric shape, all shape connected to all, in a PPM only primes are defined, like Turing world	All connected to all is an illogical, non-scientific statement, because then all are undefined and no statement could exist.

FIGURE 5.12 A table demonstrates the difference between PPM-based hardware and apparent views of a human being.

5.10 COULD PRIME-BASED COMPUTING PREDICT THE FUTURE WITHOUT PRIOR KNOWLEDGE?

In the culture of Turing-based information processing, be it classical or quantum, we deal with facts as absolute truth, gathered earlier. Here, in this book the paradigm of computing is advocated for non-facts like confusions. We do not take any facts in the new paradigm. We start with confusion, and make a journey through it, by asking question, "how many confusions have built this higher-level confusion?" Then, take one of the sub-layer confusion and go inside and ask the same question. When, we reach a known fact we do not enter. Now, the architecture of confusion is the map that helps us to understand the unknown. Figure 5.13 lists a series of factors why can we predict future in the fractal tape machine paradigm, but not in the earlier paradigms.

First, when events are represented as geometric shapes, the symmetry comes into play. It is true that events could happen in infinite ways, but the number of symmetries is finite. So, the geometricization of events ensures that events are classified in terms of symmetry. The geometric language, GML has 15 letters as 15 geometric shapes, hence, fusion of different sensory signals into one architecture is possible.

Second, when linking of events in all possible ways is mapped in terms of patterns of 15 primes, the metric of primes estimates all possible combinations of discrete events. Since the user assigns a typical composition of primes to a typical event, when a new composition of those primes appears, or even a new set of primes are linked, we get future possibilities.

Third, the geometric seed of various higher-level integration of events are integrators and the projector of future possibilities.

Fourth, a proper manifold mapping of the interaction of different imaginary worlds is recorded in the quaternion, octonion, dodecanion, and icosanion tensors. Thus, hierarchical maps of 12 layers one above another ensures projecting the future in a proper manner.

5.11 HOW PRIME-BASED ARTIFICIAL BRAIN SHRINKS BIG DATA?

Just two conceptual changes in defining what is "information" and its preferred "integration" do wonders in the existing information theory (EIT, classical + quantum information theory). Information is the 11D geometric structure of clocks and we look at its symmetry, refer to a

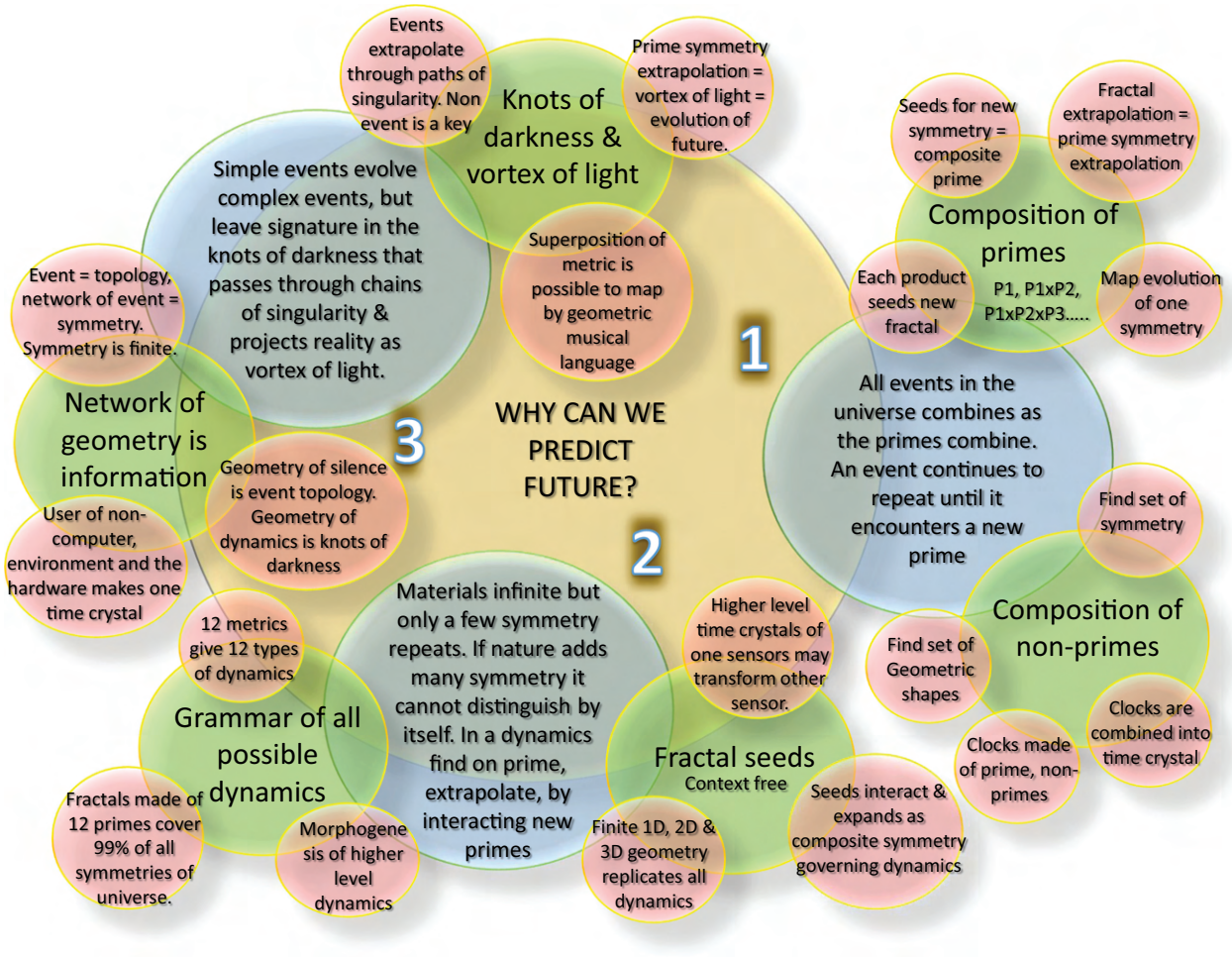

FIGURE 5.13 A chart summarizing why the proposed artificial brain could predict future without having any prior knowledge.

pattern of primes which is an archive of how to link symmetries to integrate information. Here, the universe cannot be linearized or sequentialized, the purity of fractal geometric feature has to be preserved. Now we cite 10 reasons why FIT can use much fewer resources to solve the "data deluge" and "astronomic algorithm" problems, while EIT cannot (Figure 5.14).

1. **Information is squeezed into a fractal seed that repeats to regenerate the original:** We do not store entire pixel-based data, convert it into a geometry of clocks. Not randomly, we build a fractal of fractals, following 11D time crystal's symmetry and the pattern of primes to find how to make the nested seeds of clocking geometry so that when the user implements the fractal expansion following a metric of primes, it retrieves the original pattern. Therefore, the **fractal seed is a drastically reduced 3D geometry of clocks** for the original geometric structure. Earlier in the old information processing theory, when the volume and intricate details of the content was important, not symmetry. FIT classifies the content basic on self-similarity of significance. Here fractal seeds are topologically filtered to a particular location of the hardware.
2. **The maximum change in the physical space is less than the length of minimum wavelength:** We could use one choice or imaginary path for making another loop, changes we need to make in the device geometry is very little. Thus, resources required do not increase exponentially. Just imagine with 10 states one inside another, we can have $10^{11+10+9+8+7+6+5+4+3+2+1} = 10^{66}$ states. In other words $8^{8^{8\ldots}} = 8+8+8\ldots$, we linearize the power by fractal hardware. It is a massive reduction in complexity. Since the whole architecture is a geometric arrangement of spheres, from the center of the structure 3D projections to different direction provides different information. Same architecture could hold conceptually distinct information, no need for new hardware, simply by changing the relative orientation of two structures one could add a huge amount of information in a system as time crystals, without adding a new resource.

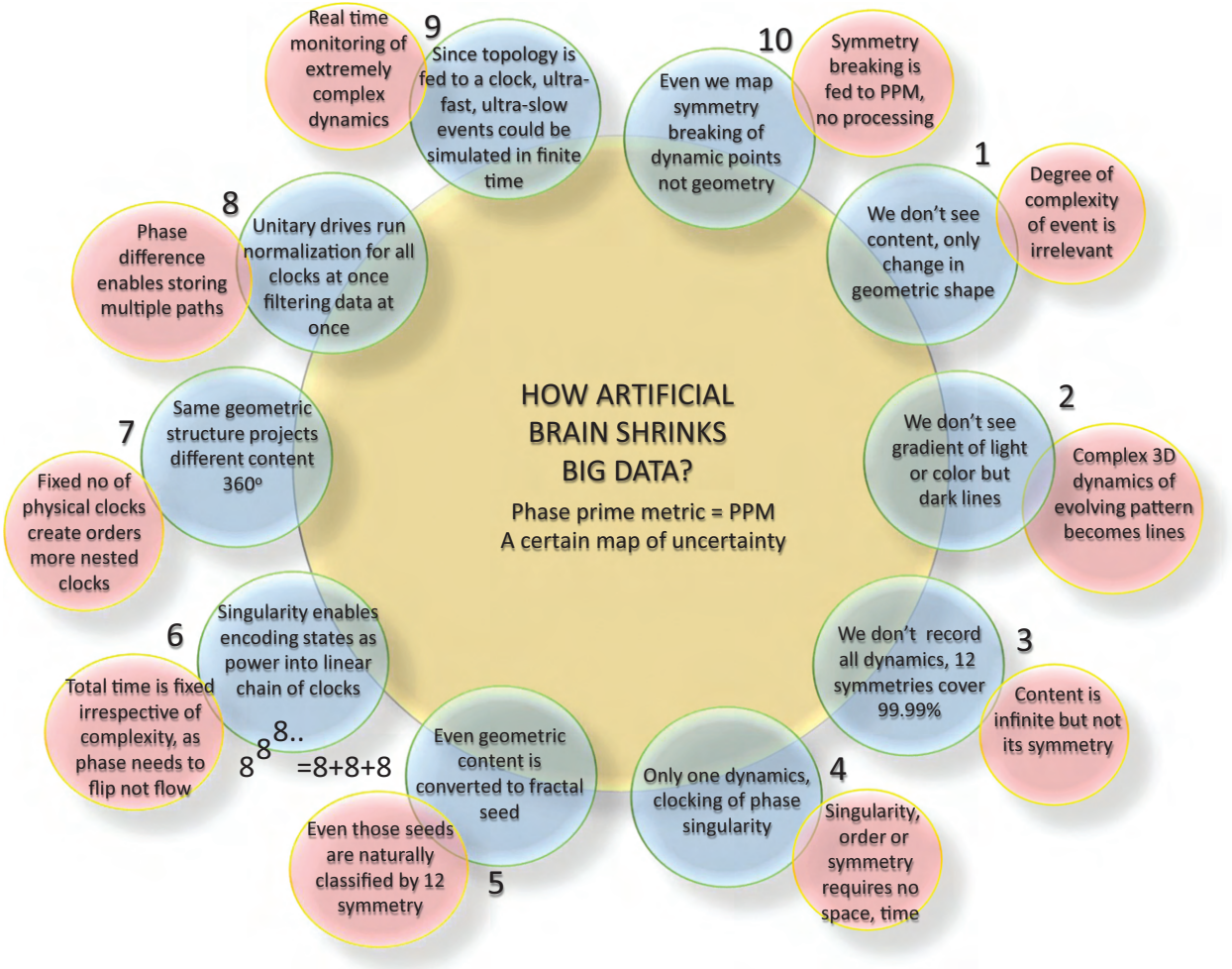

FIGURE 5.14 Ten points that describe how artificial brain could shrink big data.

3. Since **only one parameter, phase** represents all information, no resources required for compilation, transformation, addition, storage, even memorizing = processing etc. To add a new phase to an oscillating body, it does not require a physical space. **There is only one dynamics of phase change that generates the "resting state," hence no need for varieties of phenomena and their theories:** Who selects direction? Who selects the motion? Who selects the number of system points? Who selects the phase? Motion is selected by an evolution of phase, and a negative and positive sign of a phase selects the direction of rotation. **One could add new system points and generate a completely new kind of dynamics in the same geometric structure without adding a single new resource**.
4. **Total information remains constant, yet one could run an infinite series in finite hardware: harvesting infinity is feasible by projection:** If certain topology is acquired by time crystal then we do not need infinite resources or materials, one sphere could hold an infinite set of clocks by creating an infinite series of oscillations, could be analyzed using continued fraction geometric algebra. In terms of symmetry and dynamics, the choices are finite for any complexity of information. *Adding a new singularity does not require space, simply by adjusting the phase of neighboring clocks in a geometric structure one could add a new set of singularities, which means creating a new geometric architecture*. Plenty of system points along with the multi-direction oriented planes parallely rotate on the imaginary phase sphere. Hence, four parameters, ***time gap between two singularities, system point starting location, rotational directions of all time cycles (both, starting phase and rotational directions are determined by projection distinction on the reality sphere), (orientations of the planes are fixed = number of system points)*** are used to build up the information structure as universal time crystal. The line connecting the phase sphere's (previously Bloch sphere) center to the system point on the spherical surface get the information. Therefore, the complexity increases but total information remains constant.
5. **An intricate pattern of lights and darkness change their shape, it holds the dynamics of the events, no wiring required, no electronic devices are essential:** We find the 3D distribution of knots of darkness and free dark particles, also the knots of lights and free light particles in the data space, find the geometric pattern of dynamics (see Chapter 8 for details). The devices follow flux-charge protocol instead of a current-voltage protocol. Here power supply or energy consumption is not a prime concern, but geometry and dielectric constant of the material is which is a function of symmetry.
6. **New memory is written on an old memory, no need for an exclusive new space for a new memory, they may share a common space:** Experimentally, adding a new loop of poles means making changes in a group of ET cavities such that little changes make no notice locally, but when we see globally all participant cavities together, it's "the" pattern that is evident. ***It is the reason, we do not need to delete memories, all information are basic geometric shapes only, just connect them suitably; a new memory simultaneously exist with the old memory.***
7. **Singular one to all connection at the top: "Umbrella protocol," "superposition of many circuits in a single hardware":** Nested clock retrieves a higher level perception correlation, since, "everything is connected to everything" and at a higher level it is easier to find the total path, hence any problem reaches to the top first, like an umbrella. In a sequential circuit system, everything is connected to everything is not possible. Here, **in the same hardware one could connect memory elements using a network of phase, clocking direction, topological symmetry, a pattern of silence, the orientation of a particular plane of symmetries, 11D dynamic map's similarity in tensor algebra, etc**. Moreover, to add a new umbrella we do not need any new hardware.
8. **Fractal net of clocks: "instantaneous solution":** Fractal clock enables processing and analyzing at the "fractal seed" at a much deeper level than the reader's processing layer, which runs very fast. A task to be processed at a slower clock is actually solved in the domains of the fastest clocks and then the solution is returned to the slower clock. There is no search of the database even since due to symmetric fractal architecture, there are spontaneous replies by the system, **it performs a search without searching**.
9. **Unitary drive in the reality sphere at all levels of information integration:** Perpetual drive to reduce the system "unitary," An "**unitary drive**": Perpetual self-assembly for the reduction of arguments into 15 geometric shapes, never delinks from the entire environment of universal time crystal without users note but generates a drive to make the time cycle unitary. The structure finds shorter and better routes by rotating the inner planes. Even though a user does not encode intelligence, the system's unitary drive induces a self-drive for that. Geometric language could not be applied if there is no unitary drive.
10. **Various exclusively topological processing, the geometric symmetry breaking, phase transition etc by using a fusion fractal tape (FF tape) via morphological transformations of time crystal:** Geometric connection, geometric information, use of singularity, the new information theory that are fundamental to FIT and GML carries with it fractal

decomposition of bursts from singularity The nested phase network = information. ***Simpler geometry of clocks, replaces the complex clock network***.

11. **FIT-GML protocol does not have to hold in memory the actual information content during processing, hence the size of the information content is not important:** One has to find the periodically oscillating dynamic points in a topology of the distribution of data, create a 3D network of topology to find intricate phase relationships between a large number of clock patterns. Finding the same phase oscillations of the brightest and the darkest points in a 3D cloud like representation of data is the actual mechanism of information processing.
12. **No need to understand the language following which the information is written:** In any given information space, irrespective of any mode or methodology of presenting information dynamics, PPM-GML-H triad protocol finds symmetry in the dynamics with 99% accuracy. So, we do not need to understand other dynamics, or how they have written it. **Hence does not require an algorithm, all senders and receivers are encoded with a similar prime metric hardware, to determine how symmetries to be linked is a universal governing rule**.

5.12 THE LIMITATIONS AND INCREDIBLE FEATURES OF PRIME-BASED COMPUTING

What is non-computing? Definition of a non-computer (Reddy, S. et al., 2018): (a) The number of choice and quantity of information increase during decision-making instead of reduction. (b) No finite statement is found, all statements are fractal, not overlapped (Paterson, 1974). (c) There is no sequence of events, it is always event inside an event, i.e., a fractal thread. (d) No measurement happens here, superposed possibilities coexist as a distinct state. The observer becomes an integral part of the morphing of entire information content written as a time crystal. (e) All decisions are logically circular. Nothing exists without a closed-loop, even non-periodic events. (f) There is no data or fact as the decision. It is always a shape-changing geometry, the habit of looking at numbers for solutions is unfound here. (g) All solutions are incomplete. They are extended from the beginning to the end of the hardware structure. (h) Halting is never there, decision-making never stops, output continues, converges, spontaneously starts rebuilding. (i) Decision-making happens in the phase network of time crystal. Mostly, the signals remain the same, only the phase changes. So literally an observer detects no ongoing computation, still, a decision is made. (j) There is no question and answer or argument, only situations. An intractable Clique problem (searching a key pattern in a complex pattern) is solved bypassing its criticality (Feige et al., 1991; Ghosh et al., 2014a). (k) The user or observer does not write instruction. Instead "metric of prime, PPM is the programmer, it replaces the user." (l) There is no forced input. User does not search inside the hardware. Using geometric grammar, it searches its environment for input.

Here are some of the incredible features of the PPM class of computing.

1. Search a massive database without searching (spontaneous reply).
2. Multiple nested clocks one inside another enable "a virtual instant decision-making"
3. No programming is required as "cycles self-assemble/dis-assembly for better sync at all possible time scales simultaneously."
4. "Phase space" keeps "volume intact" as required resources only increase phase density not real space. Information = wiring geometry (hardware); Information = silence (not "bing" Philosophy); Information = Phase (geometric); Information = Perimeter or diameter (parametric).
5. Perpetual spontaneous editing of slower time cycles (creation/destruction/defragmentation) "prepare for unknown" = higher-level learning.
6. FIT introduces "fractal resolution," a complex signal's lowest and fastest time scale signals are absorbed, simultaneously, and during expansion, the fractal seed delivers full output, from a seed of information (drastic shrinking of data).
7. The superposition of simultaneously operating a million paths assembles into a sphere enables "extreme parallelism." In quantum, only one Bloch sphere, here sphere inside a sphere inside a sphere...
8. Time cycle is a memory, rotation along the cycle is processing, are same events, "no transport needed between memory and processing units," no wiring, no communication, no communication channel.
9. No logic gate, no reduction of choices, which ensures that "speed" is irrelevant. No bits or Qubits. The object is not measured by an observer, the object being observed is not a separate thing, i.e., no measurement. Observer, Object and Environment integrates into the time cycle (time cycle = unit of information = an event). A question is assimilated into the internal network of time cycles it affects the environment and observer in the course of assimilation. That is how a solution is derived, no computing is done to find an answer.
10. All sensory information is converted to one geometric language that allows "perception," a yellow color could have a taste. Perception is not programming as wrongly perceived.
11. It never requires rebooting, only one computing runs for whole life, but of course it sleeps when it switches off certain interactive links with nature, yet even at that time all three internal rhythm networks run. Rebooting means temporary switching of the internal rhythm integrator. It is an equivalence of consciousness.
12. The information structure self-edits itself continuously. It always spontaneously defragments the internal structure of the complete information

content represented as time crystal. However, self-editing is not so profound at the boundary clocks of a time crystal structure. There is a Gaussian distribution of editing efficiency in a time crystal architecture, the clocks in the central region edit the maximum. There are various reasons why this is so essential. (i) Boundaries cannot be so vulnerable to changes, (ii) editing requires a high density of clock boundaries, (iii) job description leaves only clocks in the middle to memorize environments, while faster clocks need to memorize hardware management, the slower clocks require to sync with the environment.

Limitations of a fractal machine: The reason that makes Fractal machine more powerful than the Turing machine is responsible for its weakness (Figure 5.15). A number of weaknesses of the fractal machine have been outlined by Gregor Drummen. First, higher level perception based on a hierarchical network of platonic geometries enable fractal machine to convert all forms of energy level signals into a singular language. That very feature also ensures a judgment error. For example, a red ball could be perceived as an apple, rope as a snake, etc. Second, since the user, machine and environment are all time crystals locked by cycles of rhythms, the machine is always ready for unknown situations, here unknown means, not encoded inside the machine. For the same reason, the machine requires to regulate and update rhythms of the environment perpetually. If mismatch is more than the machine's tolerance limit, it needs to go to sleep, so that geometric shapes rearrange to a stable structure. Third, a self-assembly of algorithm enables self-learning of the machine, writing its own software, but it can lead to irreproducible production of the non-computing machine in the industry. Since the fractal network evolves with learning, the chances are limited to recover if things go wrong. However, one thing is certain, the non-computing would not be limited to conscious expressions of life. A massive database of personalized PPM for each living and non-living systems in and beyond this planet would unveil the geometric correlations of time and space and repeatedly derive all the fundamental constants that distinguish physics, finally derive all laws from no laws (Wheeler, 1980). Only a few primes—and

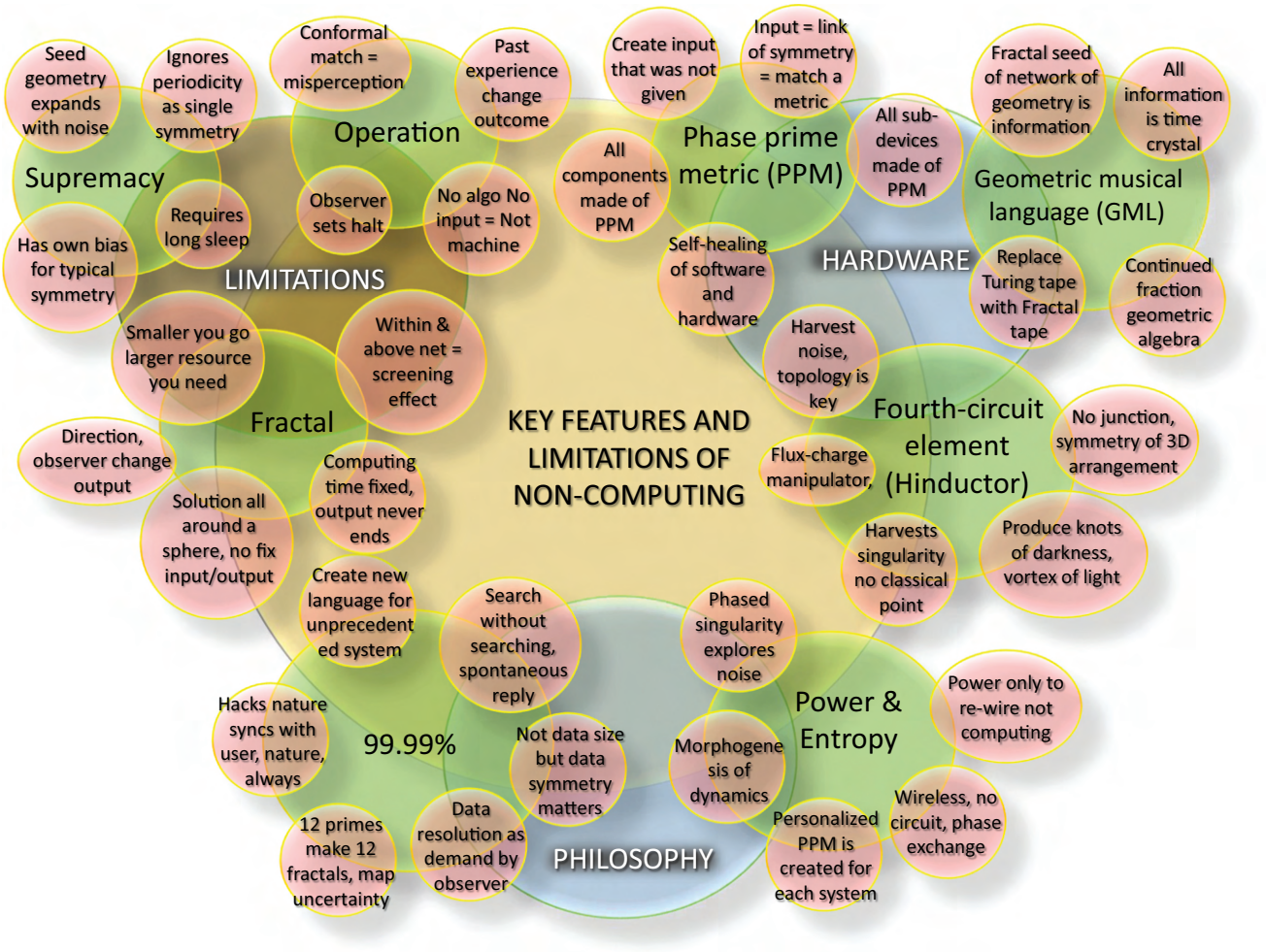

FIGURE 5.15 A chart describing the limitations of the non-computing, a new kind of decision-making using fractal tape.

explain the existence itself—as the similarly self-generated organ-like metrics of a self-synthesized information system (Haken 1988).

Critical challenges and the weaknesses of a non-computer: (i) A non-computer is not precisely accurate. It gives a global idea or perspective. A non-computer is like a life form, good at those kinds of problems that it solves most. Given different kinds of problems, a shadow of the past analytic protocols is reflected. (ii) Speed makes no sense, the total time of decision-making is fixed. Decision-making cannot end in principle. An observer or user of the non-computer captures a solution based on its own time resolution. (iii) Blindly trusts the metric prime, PPM as an encoder for all possible dynamics in the universe instead of a human user. The dynamics related to millions of primes are left out. It is similar to the culture of conventional computers, which trust that all events in the universe could be sequentialized. (iv) All 10 deliverables of non-computing are abstract in nature, not factual during processing. (v) Instead of signal the phase or silence between a pair of signals holds the key information. A 3D network of silence is the unit of information, not bits. Hence, particular clocks work (Bandyopadhyay et al., 2006a, 2006b, 2010a; Bandyopadhyay and Wakayama, 2007) but a switch alone fails. (vi) Wiring does not work; one-to-many and many-to-one communication is required (Bandyopadhyay et al., 2010b, 2010c). Hardware needs a wireless communication and a fractal network with a null screening effect (Jaeger and Haas, 2004). Here is it achieved by anomalous quantum cloaking, which enables key processing devices to sense and communicate only essential device, make others invisible. (vii) Non-computing never stops, it slows down at synchrony of clocks. Therefore, there is no static output. The answer depends on the time when the question is asked, how the question is asked i.e. observer's time crystal. Depending on the observer location around the observed, the solution changes significantly. (viii) In the conventional computer, noise disrupts the system. Here, noise is fed to activate the synchrony, finding the symmetry that matches most with the PPM. Moreover, an ordered signal affects the decision-making negatively. (ix) Addition of resource has no value. It is not the number of elements but the distinct sets of vibrations in distinct symmetries that make a powerful non-computer. (x) The solution has to be taken from all over the fractal hardware, as a projected output. There is no output and input location.

Entanglement is *one-way* traffic: Coexistence of clocks is multi-channel traffic: Quantum computing is primitive: In a quantum computer, an exponential speedup is caused by entanglement, since a single measurement can destroy all other states except the one that is desired. Entanglement is a fairly limited technology. Often, we encounter a situation where each time crystal can simultaneously be part of several other time crystals operating in a distantly located PPM-based independent system. The demand is far more technologically advanced than that offered by entanglement driven quantum computing. By analogy, this is like a person playing one drum in time with one group of drummers and another in time with a different, faster group of drummers, or playing cello in tune with one group and an oboe with another. Such wiring of time is possible by complicated phase relation between different systems. Electromagnetic resonance induced quantum cloaking ensures that a large number of entangled systems coexist independently, operate dependently for some conditions and independently for others. Fractal mechanics of multi-layered imaginary worlds is the key.

Energy conservation principle: PPM computing does not require Landau limits for elementary operation: In a PPM hardware, all clocks in the entire fractal tape run continuously, decision-making means a subtle integration in the phase space. Total energy pumped to the system always remains constant, the entire computing hardware does not require additional energy supply. The hardware is designed not to absorb any further energy, the total energy content only redistributes over the matrix. During information processing system we have a surface where energy redistributes like Gaussian 3D wave packets. The distribution of energy changes but the total energy is conserved. It is a closed system, by landau principle, bits do not change here that requires energy supply.

Limiting the PPM computer: Markov process and Devils staircase: The specialization of necessity and preparedness is one weakness of current computers. In the probability theory and statistics, a Markov process, is a time-varying random phenomenon for which memory-less-ness survives. Then, the property depends on the present state of the system, its future and past are independent, so it is called memory-less-ness. For the pattern of primes, no memory is required other than the memory of the metric, or how are primes around? The second weakness is that during training, brain jelly may not learn properly. In this case, the whole computer would be adding nonsense perspective to everything. The third weakness is that, just like humans, it can make errors of perception. Finally, this computer is not good at solving simple problems like $2 + 2 = 4$, and the accuracy is significantly compromised; existing computers are much, much better in this case. Since all, time crystals have an upper and a lower frequency, at certain limiting scales we find that signal takes constant values except at subset of points where it changes continuously, this is called **Devil's staircase**.