The Logic Fundamentals of Machine Consciousness: Theory of Tri-state

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Abstract

For a long time, the system of scientific methodology has been composed of logic, empirical (falsification), qualitative, quantitative and deterministic, and corresponding thinking tools. However, under the background of complexity science, the category of methodology should be changed, that is, on the basis of traditional methodology, non-classical logic, hierarchy, stereotype (topological invariant) and uncertainty should be added. This is also the main idea behind the "Thoery of Tri-state" in the first part of this paper.

The core idea in the theory of "Tri-state" is "Tri-state Logic" ("positive | negative | uncertain state"). The ontology of "Tri-state Logic" aims to reveal the meta space-time movement law of things transforming from one form to another, that is, the coupling of time and space in the development of things, and the orientation and evolution of the continuity of things. The mathematical basis of "Tri-state Logic" is knot theory and dynamics theory. The second part of this paper designs a machine-consciousness model framework based on the "Theory of Tri-state"

(Tri-state Logic). Its research starting point is the perspective of cognitive dynamics (cognitive psychology + dynamics), which is very different from the research ideas proposed by Minsky's "The Emotion Machine". At the same time, this paper also tries to answer Turing's questions from different space-time dimensions, and gives an experimental idea of "kindergarten game" by comparing Turing's "imitation game".

Introduction

Generally, the "Theory of Tri-state" is different from the existing natural science theory in terms of what the physical world is and the existence of quantity and quality. It is concerned with the intrinsic problem of why the physical world is so and the possible and impossible evolution of the physical world, and the origin of complex life3. It can be called a multidisciplinary meta-research methodology. As this paper is concerned, it is more about the theory of cognitive science which studies the meta level, meta energy and meta information of cognitive ontology. Of course, after all, it is only a scientific hypothesis.

More concretely, in chapter 2 of this paper, it is a meta-cognitive theory used to study machine intelligence. In other words, the "Theory of Tri-state" is the methodological basis for the construction of machine consciousness, machine thinking and machine behavior model. The first chapter of this paper expounds the methodology of "Theory of Tri-state", and the second chapter expounds the logical system construction of the machine consciousness model supported by "Theory of Tri-State"(excluding logical system of machine thinking and machine behavior).

In short, in chapter 2 of this paper, the "Theory of Tri-state" is like a comprehensive discipline methodology of geophysical research from top down, its research object is the "Troposphere" in atmospheric physics, and this "Troposphere" can be compared to the carrier of "Machine Consciousness". The "Machine Consciousness" is just like the clouds formed in the troposphere at any time due to the complex climate, which may disappear without a trace. The "Machine Thinking and Behavior" is just like the process of lightning and cumulus clouds in the troposphere

Chapter 1 The Framework of "Theory of Tri-state"

It constructed by basic concepts, principles, laws, ontology spacetime diagram and Tri-state Logic. Firstly, it is the description of core concepts. In philosophy of science, the main idea in "Theory of Tri-state" is the relativity theory of time and space, i.e the universe is not a multidimensional world, it is only a nested energy matrix infinitely. This matrix human call it "Sapce-Time" through the time. The physical world is constructed by the interaction of time and space, time and space are integrated, rather than independent coexistence. Time and space are transformed by "info

enzyme", "info enzyme" is the space-time catalyst (in physical chemistry). The intermediate staten of the transformation is the existence form of meta consciousness / meta energy. From this fusion and extension forms the continuous evolution of everything.

It should be pointed out that, in general theory of relativity, time is a one-dimensional continuum after the decomposition of time and space (3+1) is done, time is a dynamic variable. In quantum mechanics, time is an external parameter, not a kinetic operator. According to canonical quantum gravity theory4,the quantum states do not evolve over time, that is the whole concept of time as a one-dimensional continuum does not exist at all, and time is replaced by the relationship between "partial observable measurement".

In the "Theory of Relative Space-Time" in this paper, "time" does not exist, the "time" --- is an infinitesimal spacing in a universe energy matrix (limit case), and space is topological. As the physical world is concerned, the three-state superposition topological state formed by the entanglement of time and space (Tri-state Logic) has become the origin and evolution of everything in the physical world. The meta-level physical form of Tri-state overlay ransformation:

expansion, contraction and equilibrium; the meta-level physical form of Tri-state overlay transformation: energy, material and information; the meta-level mathematical physical form of Tri-state overlay transformation: positive, negative and uncertain state; the ontology of all things in the world is reflected by the Tri-state overlay transformation. From the point of view of mathematical physics, the deep understanding of the known physical world to human beings has gone through three stages: Cartesian coordinate system invariant (distance invariant), Einstein's inertial system invariant (speed of light invariant) and Euler topological invariant (Euler Characteristic). Today, we are at the beginning of the third stage. The starting point of "Theory of Tri-state" is not to focus on the phenomenological level of things, but on the deconstruction of the meta-level of things. In other words, it is to explore the deterministic reasons that behind the uncertainty presented by the physical world from a new perspective.

As human society enters the 21st century, the exploration of new phase, time crystal, dark energy, dark matter, black holes, the origin of celestial bodies, the origin of celestial life and the origin of the universe has also penetrated into the depth of space-time meta-level. Similarly, the study of human brain in life science has entered the level of bio-topological effect consciousness and meta-cognition. Therefore, it is necessary to carry out the research and construction of meta-level scientific methodology system. This is also an original intention of writing this paper. (See Figure 1 below)

Figure 1: Overall Concept Map.

The Basic Principles of "Theory of Tri-state":
- Ontological Thinking
  Space-Time, Causality, Hierarchical, Symmetrical, Holographic, Constant.
- Ontological Extension
  Quantitative, Qualitative, Causal, Positioning, Timing, Setting.
- Ontological Cognition
  Emergence, Uncertainty, Equilibrium, Continuity, Self-organization, Non-decomposition.

For more than 50 years, mathematicians have been searching for a rigorous way to prove that an unusually strong symmetry is universal across physical systems at the mysterious juncture where they're changing from one state into another. The powerful symmetry, known as conformal invariance, is actually a package of three separate symmetries that are all wrapped up within it.

"Tri-state Logic" is the meta-meta logic of physical systems, the uncertain state is the state in between of positive and negative state, however, it's main characteristic is symmetry! A recent proof by a team of five mathematicians(Hugo Duminil-Copin,Karol Kajetan Kozlowski,Dmitry Krachun,Ioan Manolescu,Mendes Oulamara): the rotational invariance — one of the three symmetries contained within conformal invariance — is present at the boundary between states in a wide range of physical systems. In other words, it means thant symmetry is universal across physical systems at the juncture where they're changing from one state into another.

Six Fundamental Laws of "Theory of Tri-state ":
- Law of Causality
  Everything has its premise and reason.
- Law of Duality
  Everything has a definite "positive" or "negative" state, at the same time, there is also uncertain intermediate state.
- Law of Holographic
  Everything has a definite space-time nesting state.
- Law of Periodic
  Everything only has its own cycle frequency of self-energy.

- Law of Emergence
  In the same space-time, a state of something may be triggered by a continuous process of activity at its own level, leading to another state from a higher level.
- Law of Now
  In the same time and space, something may be in both one state and another at the same time, that is, an indeterminate state.

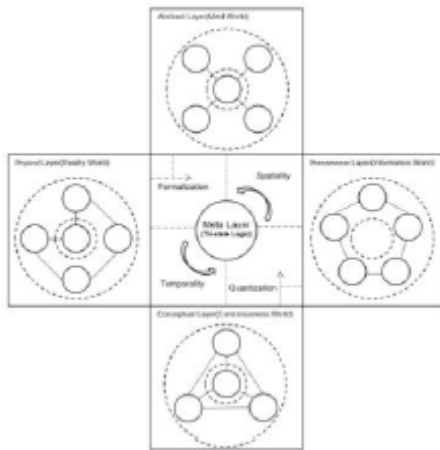**The Ontology Space-Time Map of "Theory of Tri-state"** (See Figure 2 below):

Figure 2: Ontology Space-Time Map of "Theory of Tri-state".

Physical Layer: spatial scaling and quantum phase transition in the space-time; Phenomenon Layer: periodic creation, growth, evolution, contraction, and annihilation in nature; Conceptual Layer: loop of reinforcement, weakening, and neutralization of consciousness emergence; Abstract Layer: nested paths and association effects of cause and effect of things.

From the perspective of ontology hierarchy, the space-time world is composed of physical layer, phenomenal layer, conceptual layer and abstract layer interlaced with each other; from then perspective of ontological cognitive thinking, the space-time world is composed of the interlaced emergence of the real world, the information world, the conscious world and the thinking world. From the perspective of quantum topology5, there are four categorical properties in the topology
of the space-time world:
1. Aggregation Coefficient
2. Path Length
3. Folding Order
4. Spin Degree

Based on the meta-level logic, the space-time world forms a cluster of structural networks and functional networks with spatial scaling and topological phase transition by self-organizing space-time interactions and transformations(specification fields). Whether it is microscopic particle spin, DNA knot, protein folding, macroscopic cluster turbulence, galaxy rotation; macroscopic cluster turbulence6, it is all topological in ontology.

If use the language of physics, the phenomenon of the specification field in the space-time world is described by the concepts of phase, symmetry and conservation law, in which Yang-Mills theory reveals specification in-variance. However, in the language of mathematics (differential geometry), the specification field of the space-time world is a complex "manifold" (fibrous plexus), and the intrinsic feature of a manifold is its topological in-variance, that is, Euler Characteristic. Further, in the differential geometry of a fibrous plexus, all spaces are maps of differential manifolds, are differentiable, and have a Jacobian matrix of highest rank everywhere. From this, the integral equation 7 is derived:

$$W^{\mathrm{m}} \cdot X = C \int_x \Delta_o \tag{1}$$

where C is a numerical factor, Δ_0 is a differential form, X represents a basic closed chain of the bottom manifold, $W \cdot X$ equal to the X Euler-Pangaray representation number (topological invariant).

Not long ago, a mathematical conjecture derived from 1911 --- the internal square problem (or the Rectangular Peg Problem) has been conquered, which proved that "For every smooth Jordan curve γ and rectangle R in the Euclidean plane, we show that there exists a rectangle similar to R whose vertices lie on γ . The proof relies on Shevchishin's theorem that the Klein bottle does not admit a smooth Lagrangian embedding in C2."8 The proof method is based on the topological invariant properties of the spatial rotation overlay of the Mobius band in topology. As we all known that, the elementary geometry has proved that any square has an outer circle and an inner tangent circle. Therefore, based on the proof of "Internal Square Problem", if the square and circle are nested infinitely, it can be proved that the meta-structure of an energy initial value is a closed-loop chain.

Therefore, it can be inferred that the infinitesimal space-time of the universe is formed by infinitely nested energy spheres in a discrete way, which we call it: the Cosmic Meta-energy Matrix. The so-called evolution of the universe (expansion and contraction) is actually the transformation of space-time aggregation at an infinite level.

As a result, in this paper, based on the above integral equation (1) , by dimensional analysis we use operator i instead of C to represent information(clustering coefficient of topology), operator X (x) to represent meta-energy (strong - weak), and operator T replaces ∫x Δ0 to represent time (path length-limit case of topology, mathematical name: topological phase transition, physical name: phase difference), operator S replaces Wm . X to represent space (folding order and spin of topology, spatial scaling). In this way, the above integral equation can be converted to the following meta-space-time ontology equation (for short, space-time equation):

S = iT   (2)

Space is Equal to the Product of Time and Information.

In other words, from point of view of quantum physics, corresponding to the Einstein's mass energy equation, time is mass, space is energy, and the essence of mass energy transformation is the mutual transformation of time and space, and this can also be seen as a new cognition of the physical world, i.e., the arbitrary reciprocal scale factors between space and time: information (i). As is known to all□nano photonics is a branch of physics that deals with the interaction of light with molecules and nano structures. It is found that the introduction of photon can improve the efficiency of catalyst in chemical reaction. Space and time is composed of energy, mass and information, in which "photon" is the meta energy and also the carrier of information. However, Einstein's mass-energy conversion equation reveals the role of "photons" in it. Obviously, the conversion between time and space is also catalyzed by the "information" carried by the photons.

The core of "Theory of Tri-state"--- Tri-state Logic
Before discussing the Tri-state Logic, it is necessary to make a very simplified illustration of the logical thinking pattern of human development to this day (see Figure 3 below):

Figure 3: The Logical Thinking Pattern of Human Development

Starting from the meta-point on the leftmost side, the four graphs represent naive logic, formal logic, dialectical logic and Tri-state Logic (new). In the mathematical way, naive logic is single valued (numerical value), formal logic is single multi-valued (algebraic), dialectical logic is multi-valued (function), and Tri-state Logic is multiple polymorphous (topology). From the point of view in mathematical physics, the development of naive logic to Tri-state Logic is a space-time conversion from simple discrete energy points and lines to complex continuous energy bodies. In the other words, the binary rules of the law of contradiction, and the law of excluded middle in traditional logic are incompatible with law of Tri-state Logic. Based on the study of traditional monotonic logic, non-monotonic logic, multivalued logic and modal logic, and in combination with the scientific and philosophical view of the "Theory of Thi-state", we have developed a new form of meta logic, Tri-state Logic (see Figure 4 below):
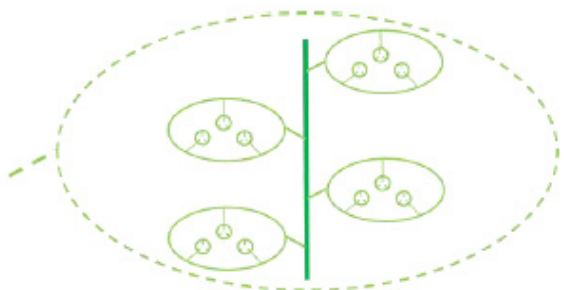

Figure 4: Conceptual Diagram of Tri-state Logic (leaf diagram)

Its dominant property is the causality and symmetry of space-time, and the invisible property is the holography and superposition of space-time. : Cell, an infinite loop nested meta meta logical mode. From the point of view of life science, the complex evolution of cells is the entanglement of living DNA, that is, the writhing number of a curve in Euclidean 3-space, introduced by Calugareanu (1959-61) and named by Fuller (1971)[9]. From the mathematical point of view: In 2011, Peter Scholze proposed a mathematical concept called "perfectoid spaces"[10], which combines topology, Galois theory, and p-scores, where the p-integer is modular based. For example, we classify integers by a higher power of 3, and 32(9) integers modular to 3, 9 and 27 are stacked layer by layer like a tower, we can build a tower with an infinite number of layers, each three times as many as the one below it, and that pattern will continue, this also formed the "perfectoid spaces" proposed by Schultz. In this paper, the mathematical concept of "perfectoid spaces" can be used to describe the cycle nested superposition mode of "Tri-state Logic". From the physical point of view, Maurray Gell-Mann proposed the quark model ((the simplest three-state representation of the SU(3) group) in 1964, where that each baryon consists of three quarks (or anti-quarks), and each meson consists of two quarks (or anti-quarks), where gluon is the propagating particle with strong interaction between quarks, gluon field is also SU(3) group (symmetric), it has 8 generators (8th order Lie group), and gluon spin is 1.11 From the evolution of basic particles to the process of Gell-Mann defining Quark to the unification of weak interactions and electromagnetic forces, a complete standard particle model of physics can be seen. In this paper, it can be the display image of "Ti-state Logic" at the level of matter element in the presentation layer.

The ontological form of Tri-state Logic (see Figure 5 below) in is inspired by Hans Reichenbach's "Philosophic Foundations of Quantum Mechanics"[12], the other two are by the ancient Chinese Yang Xiong's "The Book of Taixuan"[13] and Buddhism's three-branch logic. At that year, the emergence of Hans Reichenbach's Thee-Value Logic (also known as quantum logic) was also an attempt to describe and explain the logical basis behind quantum mechanics, but unfortunately, it did not stand. In contrast, the essence of Tri-state Logic is to change the traditional three value logic's "numerical" expression to "state" expression, from the original "true | false | uncertain value" to "positive | negative | uncertain state". It seems to be a transformation from "value" to "state", however, the essence is a meta-logical form closer to the real existence of the physical world.

The Tri-state Logic ring is a cycle-by-cycle meta-space operation, which evolves from meta-state, dual state and neutral state. The neutral state is an overlapping state of three states, whose constitutive form is equivalent to the Borromean Rings originating from ancient Hinduism (the three rings do not interact with each other).
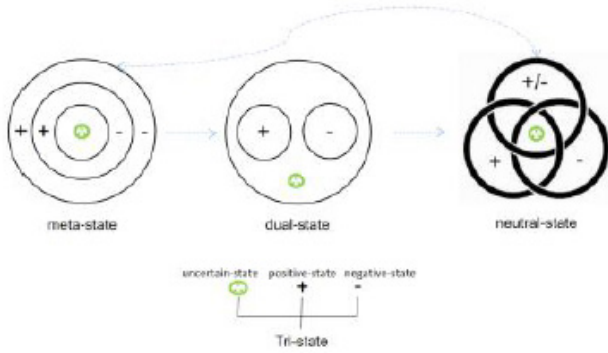
Figure 5: The Ontological Form of Tri-state Logic

In the field of philosophical world, the ancestor of Buddhism, Sakyamuni, said that there are three phase of cognition: the transformation, the karma and the truth. The ancient Chinese philosopher Laozi said, "Tao produces one; one produces two; two produces three; and three produces everything."14

In a 1977 paper by Chenning Yang15, the internal relationship between magnetic monopole and ordinary plexus and extraordinary plexus is involved: "Why is electromagnetism without monopoles "trivial"? We cab gain some understanding by looking at a paper loop and a Moebius strip. If they are cut along the dotted lines, each would break into two pieces. Looking at the resultant pieces, we cannot differentiate between the two. The paper loop and the Moebius strip are different only in the way the resultant pieces are put together. For the latter, a twist of one of the resuitant pieces is necessary. The difference between a trivial and a nontrivial bundle resides only in the processes of joining: for the nontrivial bundle, a twist is needed in the joining process... If there is no monopole, S= 1, and the bundle is trivial. If there is a monopole, S = 1, and the bundle is nontrivial. (We may describe the nontrivial nature by saying that a twist of phase is necessary.)"

The "S" value mentioned in this paper is derived from the Schrodinger equation solution: "The Schrodinger equation for a electron in the monopole filed is thus

$$\frac{1}{2m}\left(p - eA_a\right)^2 \psi_a + V\psi_a = E\psi_a, \ in \ R_a \ ,$$

$$\frac{1}{2m}\left(p - eA_b\right)^2 \psi_b + V\psi_b = E\psi_b, \ in \ R_b \ ,$$

where ψ_a and ψ_b are, respectively, the wave functions in two regions. The fact that the two vector potentials in these two equations are different by a gradient tells us, by the well-known gauge principles, that ψpa and ψpb are related by a phase factor transformation

$$\psi_a = S\psi_b \ , S = exp(ie\alpha) \ ,$$

(or)

$$\psi_a = [exp(2iq\phi)]\psi_b \ , q = eg \ ."$$

From this we can extend to the topology of Tri-state Logic:

Figure 6a: Trivial Chain Ring   Figure 6b: Nontrivial Chain Ring

From the theory of knots, we know that, Figure 6a is a trivial chain with a single direction chirality, no phase twist; Figure 6b is a nontrivial chain ring (Mobius Ring) based on a trivial chain ring, it has different chirality (black arrows pointing forward and backward) at the same time, that is, the phase is twisted. Corresponding to the positive and negative uncertain states of the Tri-state logic, the red triangular loop in the graph represents the uncertain states in the three-state logic loop, and the left and right black arrows represent the positive and negative states in the three-state logic loop. The uncertain state is an intermediate state, which exists in the torsional process interval of topological phase transition. In this paper, one point needs to be very clear: in the micro-world, the topology of Tri-state Logic does not mean that particles at the micro-particle level are topological, but that the space-time fields formed by micro-particles are topological.

At the same time, from the perspective of ontology cognition (reality) of the quantum world, we boldly assume that Tri-state Logic is the "meta-logic" of the quantum world (quantum states have reality), which is the logic basis behind the superposition of quantum states, quantum entangled states, and quantum phase transitions. The "meta-states" of the three-state logic correspond to the "Quantum Form"; the "dual state" corresponds to the "entangled state"; and the "neutral state" corresponds to the "superimposed state".

It should be pointed out that Harrigan and Spekkens provided a categorization of quantum ontological models in 201016. Pussey et al.17 proved that if a quantum system satisfies thontological model of quantum mechanics and the assumption of independent preparation of quantum states, then a quantum state is real --- there is no intersecting compact set of the ontological distributions corresponding to any two non-orthogonal quantum states in 2012, and this conclusion is called the "PBR Theorem". However, from the scientific and philosophical point of view, PBR theorem only reveals the relationship between representation (quantum state) and reality (ontological state) in quantum mechanics, not the reality of quantum state.

In order to understand the following description based on the Tri-state Logic mathematical model, it is necessary to briefly recapitulate the superposition principle of quantum state and the principle of entangled state:

Principle of Quantum State Superposition

Assuming that a quantum object has two definite possible states, 0 or 1, usually written as: |0>, |1>, because the quantum state (written as | ψ >) is uncertain, it is generally not in the |0 or 1 definite state, it can only be in the state of superposition of these two definite states according to some influence, expressed mathematically as:

|ψ >=| a | 0 > + β | 1 >, where α and β are complex and satisfies |a | 2+ | β | 2 =1.

Principle of Quantum Entangled State

Assuming that the quantum object is two electrons with different spin directions --- electron 1 and electron 2, its spin properties are mathematically expressed as:

$$\Psi = (|00>_{12} + |11>_{12})/\sqrt{2} = (|0>_1 \otimes |0>_2 + |1>_1 \otimes |1>_2)/\sqrt{2} \quad (3)$$

Unable to write $|\psi>_1 \otimes |\phi>2$, as the tensor product of two quantum states, which is the entanglement of two electrons. The subscripts 1 and 2 indicate that this is the quantum state of electrons 1 and 2, taking the Z component representing the spin up and the Z component representing the spin down.

Thus, by the way, it may also be possible to find some clues in the category of "Tri-state Logic" in the question of how the uncertain micro-quantum world has evolved into a definite macro-classical world in the physical world all along.

The Basic Principles of Tri-State Logic Based on Quantum Thought:

- The implicit order or explicit behavior, subjective or objective cognition of the objects are entangled with each other.
- Space-time ontology is an overlapping state of energy, material and information, and time and space can be transformed and deformed with each other.
- Subjective and objective world activities cannot be separated from the space-time context of quantum phase transition.

The basic concepts of Tri-state Logic consist of --- the influence of the participants (independent events, non-independent events, neutral events), the hedging of space-time (strength, emergence, balance), and the scaling of space-time (endogenous, synchronous, topological).

From the point of view of traditional mathematical logic, the "cell" of Tri-state Logic is neither a Boolean logical algebraic mode nor Frege's logical function mode. In other words, the expression of Tri-state Logic is an abstract artificial language, but it is not composed of the traditional semantic and syntax rules, it is a logical topological mode similar to the natural clover form (see Figure 7 below):

Figure 7: The Ontological Structure of Tri-state Logic

As we all know that, according to the famous Li-Yorke Theorem18, "Period three implies chaos" is an important theorem for characterizing deterministic chaos. Here, we borrow to use in the concept of "Tri-state Logic", we can clearly see that it is precisely the reverse proof of the "Tri-state Logic" of the ontology structure of clover. There is another physical validation: in 1975, Faddeev proposed a stable soliton solution within the framework of the Skyrme-Faddeev model19, whose topological structure can be described by Hopf invariants (Hopf invariants, or Hopf charge, abbreviated as QH), so this kind of topological soliton is called Hopfion. The three-dimensional real space endows Hopfion subgroups with various topological structures, which can form ring, chain and knot structures, the corresponding topological properties are described by homotopy group Π 3(S2), this topological invariant (i.e. Hopf charge QH) can be understood as linking number. Bogolubsky[20] first proposed such a model in 1988,

$$H = -\sum_{<i,j>} J_{ij}\, S_i \cdot S_j,$$

that is in a Heisenberg model of cubic lattice, the nearest neighbour interaction of four layers is introduced, where ij J is the nearest neighbor interaction between different lattice points. In this model, a stable Hopfion can be obtained, which can be approximated as a damping magnet model. In 2017 Sutcliffe21 used this damping magnet model to obtain a variety of stable magnetic Hopsion structures, including the trefoil knot like Hopsion with QH of 10, demonstrating its rich spin structure. The initial evolution state of "Tri-state Logic" can be described by the following two basic equations:

Mathematical Expression1

Derived from the equation of toroidal junction22 in knot theory (derivation process is brief):

pϴ = qφ+ 2kπ (θ ,φ is the angular coordinate; p, q is fixed integer; k is arbitrary integer)　　(4)

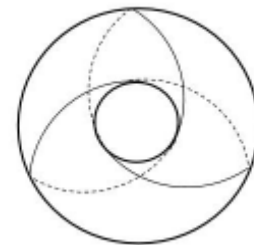Figure 8 obtained: $T_{p,q} \rightarrow T_{2,3}$

Figure 8: Space Time Composition.

Mathematical Expression 2

From the knot theory, the topological invariant of the knot also represents the energy23. It is known that the energy number of the knot invariant of a closed loop is: $2\pi c + 4$ c: The number of intersections of a knot projected on a two-dimensional plane.

(Note: Chern number can be regarded as the integral of some external differential forms on the manifold, which is a topological invariant. The total Bailey curvature in the two-dimensional phase space of quantum hall effect4 in condensed matter physics can

be obtained by 2ΠC, where C is an integer, which is called the first kind chern number of --- Shiing-Shen Chern) The expression equation of "Spatial" frequency in Fouier Optical Theory[24]:

$$K = 2\pi f \quad K\text{:Spatial Angle Frequency} \quad f\text{: Spatial Frequency} \quad (5)$$

The above C in the energy expression of knot invariant, if it connects with curve, it is a waveform, on the other words, it is frequency. As a result, the spatial frequency f and c are equivalence in the "Spatial". Thus, the space-time ontology equation of "Tri-state Logic" is derived(derivation process is brief):

$$E = A\exp(j2\pi f\, xx) \quad E\text{: Energy Level; } A\text{: Amplitude } A=1,2,3....n \quad (6)$$

Mathematical Expression 1 is the description about space coupling and continuity, it is the constitutive equation of object, Mathematical Expression 2 is the description about space causality and energy, it is the ontology equation of object. In the other words, ontology equation can also be regarded as the mathematical expression of human consciousness thinking logic (meta-consciousness equation).

(Digression 1: The ontology equation which is based on the Tri-state Logic ($E\, A\exp(j2\pi f\, xx)$)

also can be used to prove the Riemann Conjecture concisely.
The Riemann Conjecture is expressed as: all the nontrivial zeros of the Riemann ζ function are located on the critical line.

The Mathematical Expression Re(s) = a , lm(s) = b , in the interval of a + bi complex plane,

$$S = 1/2 + bi . \quad (7)$$

The logic path of proof is following:
Firstly, draw a circle with radius 1/ 2a in the interval of a+bi complex plane, according to the knot theory, the nontrivial zeros of knots and chains are distributed throughout the whole ring of complex plane densely. Then according to the topological invariant properties of the spatial rotation overlay of knots(symmetry,transformation), turn the circle in the complex plane 90 degrees left or right with1/ 2a as the center point, thus it forms a coaxial spatial overlay with critical line.

Lead into E = Aexp(j2 f xx) equation, since E is a primitive function, it is not a constant,

as a result, it can be concluded that the energy series E will be trended into infinite, and it is distributed in a discrete form in a space overlaid coaxially, thus, an infinite extension over the overlapping critical line. Therefore, it can be solved that all the nontrivial zeros are on the critical line.)

(Note: why is there such an episode about the proof of Riemann conjecture in this paper? This is a tribute to Riemann. Because

of his view on the natural forces of the universe: natural forces are caused by the distortion of geometric structure. This coincides with the author's point of view, and the above logic proves that the thought behind it is also consistent with Riemann's thought.)

The ontology of Tri-state Logic aims to reveal the law of meta space-time movement of things' transformation from one form to another(quantum phase transition), that is, the coupling of time and space of the development of things, and the evolution of the direction and state of things' continuity. It is universal to all kinds of things under the same constraints, that is, unified meta logic. At the same time, it is also a kind of meta space-time order, a priori order of the world. Tri-state Logic is a kind of space-time meta mode to show the will of the universe, it is based on the evolution of the primitive of things to recognize the current and future meta space-time state of things.

According to the basic principle of "Theory of Tri-state", the internal structural attribute of Tri-state Logic is the interwoven network of multiple causality and holographic space-time. The core characteristics of Tri-state Logic are space-time, causality and uncertainty. Among them, space-time includes non-linearity, periodicity and symmetry; causality includes diversity, circularity and nesting; uncertainty includes polymorphism, emergence and superposition. The meta-information inference mode of Tri-state Logic: according to the ontological regularity of meta-levels (Law of Causality, Law of Duality, Law of Holographic, Law of Periodic, Law of Emergence, Law of The Moment), cognitive modeling is based on the four-in-one integration of scale, topology, context and orientation of space-time. During the process of reasoning, the concept of relative space-time is established, thus, multi-times-cale, hierarchical, multi-loop, self-organizing, self-adapting, etc. The main forms of expression are analogy, induction, simulation, reflection, association and prediction.

In a further step, through the mathematical physical model based on Tri-state logic, the whole process of life activity in life science can be simulated, reproduced or reproduced effectively, and the law of life topology and time-phase change and the form of material, energy and information transformation can be reconstructed. On this basis, artificial intelligence is used to describe the cognitive model of human holographic life system, describing the state of life activity, mental state, health level, disease degree, treatment effect and outcome with qualitative and quantitative positioning.

Summary
If we examine "Hume's Question"[25] from the perspective of cognitive science,we will find that Hume's proposition of "yes" and "should" is actually the speculation of "fact proposition" and "value proposition", more essentially, it is the speculation of methodology of "natural science" and "social science". Because the cognitive science system before the "Tri-state Logic" lacks a unified cognitive logic ontology, that is, it can not integrate the cognitive research of natural science and social science, and the "Tri-state Logic" ontology is both of them, which has both quantitative

causal reasoning and qualitative perceptual understanding. In other words, the core ideology of "Tri-state Logic" is embodied in the evolution of space-time meta structure and situation.

Chapter 2: The Logic Fundamentals of "Machine Consciousness"
From the point of view of mathematical physical computing, the Tri-state Logic is a topologically computable logical framework system, which consists of linear temporal logic, nonlinear space logic and information chain. Linear temporal logic is based on the extension of Amir Pnueli26 linear temporal logic, adding a concept definition of "indeterminate time zone"("uncertain state"); nonlinear spatial logic is based on the geometric (knot) invariant (curvature and potential function) polynomial of the nonlinear dispersion equation of Ricci soliton in the soliton theory27, and the contraction, stability and expansion modes of Ricci soliton corresponding to three state logic ontology under the condition of complete and non-compact manifold. At the same time, the non-parametric information stream model with the characteristics of "nonlinear time series" is combined.

In short, as far as machine intelligence is concerned, the positioning of Tri-state Logic is the description of the underlying abstract logical modal structure of cognitive system (intelligent machine with self-consciousness, thinking and behavior). It can be regarded as the universal logic, this generality also makes it to be a basic support framework for general artificial intelligence (AGI) as well at the moment.

We say that the ontology of everything has its structure, but the underlying logic that supports the structure is often unclear. The Theory of Tri-state attempts to analyze and describe the underlying logic of the cognitive system as an ontology, and then achieve the goal of constructing the cognitive system through the cognitive modeling, mathematical model and system model at the upper level. It needs to be particularly clear that the logical basis of "machine consciousness" in this paper refers to the study of meta-logic and meta-cognitive level, which belongs to the study of abstract linguistic thought (model) rather than the implementation description of engineering technology (algorithm).

Currently, the implementation of general artificial intelligence requires the construction of a new abstract logic layer based on Tri-state Logic in the system layer of Turing machine which we call it: space-time hippocampus. This logical body is the force (endogenous: internal drive) of the machine generates self-consciousness, and its functions are described in mathematical terms: spatial scaling and topological phase transition (topological excitation of knots); its physical mechanism is described in the language of this paper's relative space-time theory: the synchrony and diachronism of evolution. In the future, quantum computers will have a natural fit with this logic at the bottom.

We believe that the machine brain is a physical (energy) system, a dynamic system with definite causality (cognitive science is called cognitive system, complexity science is called complex system).

Its operating mechanism can be simulated by mathematical, physical, non-linear differential equations and topological formulas. In the small world of the machine brain, the predictability of the overall behavior of the system depends on the initial premise, information enzyme and final conditions of its physical space-time operation. The object of study of machine consciousness in this paper is human-like consciousness, psychology and intelligence, which can be regarded as a cognitive functionalist paradigm: constructing a new cognitive computing system through cognitive dynamics method based on "Tri-state Logic" for cognitive modeling and simulation.In other words, brain function simulation (Brain-Inspired) is based on the theoretical framework of "Tri-state Logic". It predicts the development of uncertain problems by expressing them as mathematical physical spatial scaling and topological phase transition processes.

According to the global neuron workspace theory of S. Dehaene28, a contemporary cognitive neuron scientist, the so-called "consciousness", that is, a mechanism for information sharing. The state mechanism in which an organism perceives an external object, its own body and behavior, its inner feelings or thoughts, etc., with explicit content, is called conscious access, or "awareness". It is a spiral rising cycle, not a simple repetition. In this paper, the concept of "consciousness access" corresponds to the concept of "chain winding" in knot theory and the concept of "Helicity" in topological fluid mechanics. Dehaene also proposes three core functions
that need to be improved in the consciousness of successful simulation of artificial intelligence, including the need for a global workspace-like information sharing mechanism between programs, brain-like learning mechanism of the program itself, and spontaneous behavior. The structure construction of machine consciousness device in this paper draws lessons from Dehaene's thought to some extent.

In general, machines do not have biological power and active mechanisms, but in this paper, machine consciousness is a tightly coupled endogenous system in the machine brain. Its recurrence effect, emergence and uncertainty are determined by the nonlinear dynamic form within the limited physical constraints of the system. The "Endogeneity" --- a specific physical transformation caused by ontology and has the ability to continuously transform any input object. It is not the imitation and accumulation of external existence, but the verification of internal
cognition.

Machine hardware is the carrier of machine consciousness and machine consciousness is the carrier of machine thinking and behavior. In other words: computer is a logical machine, machine intelligence is based on machine logic. It is well known that dynamics (including non-linear dynamics, non-linear optics, quantum optics, topological fluid dynamics and topological quantum field theory, etc.) studies how a physical system evolves from one state to another over time, how a particular state follows its trajectory and the properties of these trajectories and their relationship.

From the mathematical physical point of view, the dynamic system (including the topological quantum system) can be considered as an abstract topological geometric spatial structure (which is called state space in mathematics, phase space in physics, and topological quantum phase transition in topology), where each point in space corresponds to a particular state of the dynamic system. The source of this continuous state change is meta-energy exchange, that is, spatial scaling and topological phase transition of space-time energy field. It is emphasized here that the space-time topological scaling phase transition is based on the evolution of a new cognitive logic mode in the theoretical framework of machine consciousness in this paper, that is, Tri-state Logic, which belongs to the category of cognitive dynamics (Interdisciplinary Studies in Consciousness Psychology and Mathematical Physics). At the same time, this is also the topological definition of machine consciousness in this paper.

The Logic Principle of "Machine Consciousness"
In short, the following text of "Machine Consciousness" logic principle can be regarded as a specific application example of the "Tri-state Logic" model thought in the "Theory of Tri-state" in the field of machine intelligence. The origin of machine consciousness: based on the ontology of "Tri-state Logic", and using the ideological framework of cognitive science, complexity science and consciousness science for reference, the cognitive intelligence mechanism of machine is constructed, that is, machine cognitive structure --- machine personality (consciousness, thinking, behavior). Continuing the above the "Theory of Tri-state", consciousness is a kind of field: consciousness field, that is, a representational space-time field, and thinking is the N-class links of information fluids in consciousness field. This paper only focuses on the "machine consciousness" part of machine personality.

Penrose[29] interprets consciousness as the result of the collapse of a quantum wave function in a micro-tube under gravitational forces. In some sense, this is the content that gives consciousness reality. We do not comment here on whether human consciousness constitutes quantum collapse. However, Penrose's theory of consciousness contains the characteristics of randomness, non-logic and non-domain of quantum consciousness, as well as the introduction of quantum computing logic gate correspond to the "machine consciousness" in this paper to some extent. Therefore, in this paper, the "Meta-Consciousness" logical model partially absorbs the views of Penrose's theory of consciousness, in which we would like to express our sincere gratitude to Professor Penrose.

In addition, the study of condensed matter physics[30] shows that there is a deep relationship between the symmetry of the topological phase and the topology, one is dependent on the existence of symmetry, and the other has extraordinary topological characteristics even if symmetry does not exist in the system. Furthermore, from one quantum Hall state to another, the only change is the value of topological invariant rather than symmetry. At the same time, in topological quantum computation theory[31], the non-Abel quasi-particle state space is also closely related to topologically

invariant kink polynomials in knot theory, which can be interpreted by Chern-Simons canonical field theory and two-dimensional con-formal field theory. This topologically-related degenerate space is the physical basis for quantum computing in topology, it can be used to store quantum information. At the same time, any sub-unit can be braided to achieve the common logic gate group required for quantum computing.

The difference in machine consciousness is embedded in the "meta-consciousness" (artificial consciousness, machine consciousness generator) of each machine.In other words, robots are different, they are not all carved in a single model, that is, the generation of machine meta-consciousness of machines is not derived from equations based on mathematical axioms, however, it is on the autonomous response to internal and external causes, and it has an endogenous mechanism of self-emergence at the energy level, which makes the perceptual correlation of different machines different is different, moreover, it leads to differences in the relevance of behavior, that is, what the relevance means to humans. Machine meta-consciousness has its original characteristics, it is an untouched meta-state, and it is also the meta-point of the same frequency resonance of the energy field. Machine meta-consciousness can be regarded as the basic unit of human-like consciousness.

The basis of Tri-state Logic model of machine consciousness.
The Tri-state Logic model is the cognitive logic basis behind machine personality. Its physical form is an endogenous space-time energy field. From the cognitive point of view of the conscious world, the "meta-state" shown on the left in the "Tri-state Logic Ontology Diagram" is the unconscious state; the "dual state" shown in the middle of the diagram is the subconscious state; The "neutral state" shown on the right is the state of consciousness. Its adaptability promotes the stable choice and direction choice of space-time orientation state. Its symmetry forms the unity of space-time state, and asymmetry forms the pluralism of space-time state. The situational concept model of machine consciousness (see Figure 9 below). Situation model is the concrete form of Tri-state Logic model in logic machine. There are three basic states of machine consciousness degree of expansion, degree of equilibrium, and degree of contraction.
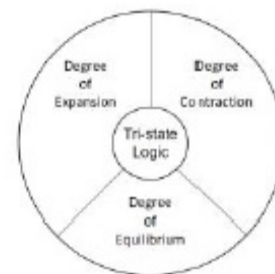

Figure 9: Situation Concept Model (Lifebuoy Model)

Among them, the degree of expansion refers to the extroversion of machine consciousness and the degree of external antagonism; the degree of equilibrium refers to the stability of machine consciousness and the degree of equilibrium to the outside;the degree of contraction refers to the autistic and introverted degree of machine consciousness. All three are mirror images of human beings, and

they are also directed, that is, they have the attributes of emptiness, purpose and directional. All these are regulated by the dynamic topological structure of the situation model based on Tri-state Logic and the self-organization and feedback of the stream of consciousness (SoC).

From the point of view of the development of information theory, the information structure of consciousness is not a discrete collection of information in the traditional sense, but a continuous stream of information, from beginning to end, boundless and from side to side. At the same time, it also has the chirality mentioned in physics and the directivity in cognitive psychology (cognitive psychology holds that psychological phenomena are intentional, that is, always pointing from the front and back the both directions). Generally, animal and plant consciousness refers to the force exerted on the change of space environment and the passage of time. For machine consciousness, it focuses on the formation of event perception, internal and external factors and the state of space-time and the state of the recognized body. The initial form of machine consciousness is the unconscious state formed by the fusion of multiple cognitive causality and related energy fields.

"Machine Consciousness" Modelling 1
Firstly, based on the theory of Tri-state (Tri-state Logic / situation model) unified cognitive modeling thinking, we think it is essentially the cognitive modeling of space-time (see Figure 10 below), because its connotation contains the following four points:
1. Objective Conformity --- it could simulate the representation and process of human thinking (meta-cognition)(law / logic);
2. Scaling Scale --- it could simulate the real world of time series;
3. Mass Granularity --- it could simulate the behavior correlation of human thinking;
4. Quantity Aggregation --- it could simulate the trend of human group behavior.

The machine consciousness model can be regarded as the basic unit model of human-like cognition. That is, the concepts of "blocks", "perceptual objects" , and "time gestalt" of cognitive basic units (cognitive basic variables) of Rational Choice Theory (RCT)32 in cognitive science construct a unified human-like cognitive model by transforming the endogenous situation model. Gallagher mentioned in "Action and Interaction": Cognition cannot be explained by neuronal processes alone, and an interdisciplinary approach constitutes a "Dynamical Gestalt"33.
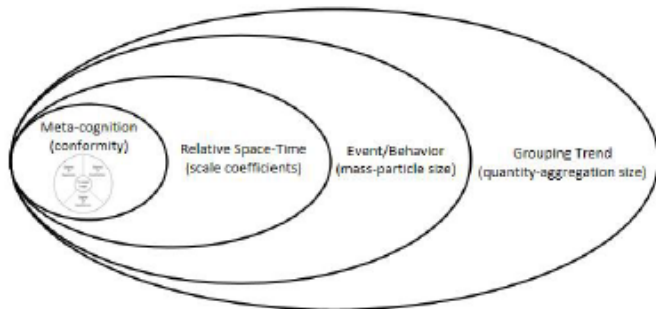

Figure 10: Cognitive Conceptual Model

Therefore, we present the following meta model of "relative space-time" based on the concept of cognitive modeling (see Figure 11 below)
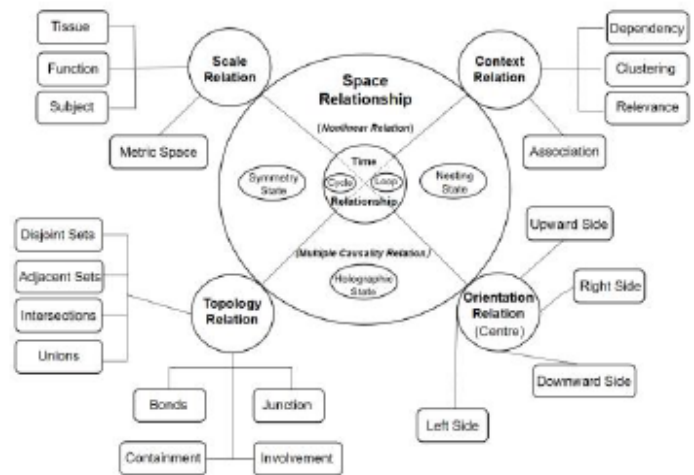

Figure 11: Meta Model of Relative Space-Time

"Relative space-time" includes scale, topology, context and orientation, the kernel is the uncertainty and multivariate state of space-time. In other words, it is to determine the cause, location and einstellung the space-time situation at different space-time scales (coordinates). Secondly, from the point of view of complex systems, the characteristics of "relative space-time" are emergence, multi-time scale, hierarchy, multi-loop, uncertainty, non-linearity, openness and topology. This results in continuous changes in space-time, tight coupling, self-organization, adaptive and feedback effects, and so on. Furthermore, the basic elements of mathematical modeling are naturally derived, that is, the cognitive computing model which accords with the above characteristics of "relative space-time" meta-model. But in this paper, we will only focus on the mathematical modeling of "machine consciousness". The mathematical modeling of machine thinking and machine behavior will be recounted separately.

The key elements of mathematical modeling of "machine consciousness" are as follows:.
•	Construct the consciousness model based on the endogenous Tri-state Logic/situation model: non-linear, holographic, symmetric, overlapping, nesting, hierarchical, etc.
•	Construct the consciousness model with cognitive causal effect, topological phase transition, energy conversion, periodic loop (loop), context, emergence, criticality and other state information continuity mechanisms and space-time information stream storage modes.
•	Define and describe the mathematical and physical methods of input and output, information processing, state transformation and evolution in the consciousness model.

By analogy, time is algebra, space is geometry; time is linear, space is nonlinear; time is causality, space is energy. Causality and

energy are two major components of machine consciousness modeling. Here causality is a condition, a period, a frequency, and a time series; energy is an emergence, a state, an entanglement, and an overlap. Machine consciousness is essentially a causality cycle and energy change in "relative space-time". It is event and model driven, and its abstract conceptual expression is: space-time model * (causality stream+ energy stream) = machine consciousness. ($STM \times (SoC + SoE) = MC$)

In other words, the emergence of machine consciousness consists of two parts. First, the input stimulus stream induces linear and nonlinear responses in the dynamic consciousness model, and then, when the consciousness model generates positive-negative neutrality feedback loop and output, it is nonlinearly associated with the input stimulus source, which leads to the generation of a new feedback loop, forming a circular nested endogenous interaction process, that is, machine consciousness. The first process follows the constitutive diagram of "Tri-state Logic", and the second process follows the ontological equation of "Tri-state Logic".

"Machine Consciousness" Modelling 2

Review: the early Turing computer simulation was based on the assumption of physical symbol system (symbolism) for information processing of knowledge: knowledge representation, knowledge reasoning and knowledge application, which was essentially a symbolic sequence processing mechanism based on logic and rules. In other words, it is a mathematical logic-based interpreter that performs the tasks they are labeled for by interpreting the deterministic values of a series of inputs, and it is a passive executor. It gives a mathematical logic interpretation of "what is calculation".

Since 1970s, artificial intelligence research paradigm based on connectionism (bio-mimetic structure: neural network) has emerged, which uses unit ratio as neuron and describes cognitive process by interrelation between units. It is considered that the connection weight between input unit and output unit can be continuously transformed by learning and does not affect the whole information processing. In other words, the concept of mathematical calculation behind the current computer depth learning framework is essentially to combine some differentiable computing units into a program, and then adjust the program parameters by gradient optimization, and make it achieve the desired, with a clearly pointed known goal. From the point of view of mathematics, it belongs to the category of combination mathematics and computational mathematics.

Traditional computer science (Simon, Minsky1) constructs two features of artificial intelligence computing mode: representation and frame information processing. It interprets the question of "what is information", that is, information is deconstructed into physical symbols as a representation of text, images and thinking (abstract thinking), information organization can be understood as concepts, objects and events. Information processing uses a step-by-step procedural framework to aggregate and adjust information

to achieve the desired results. However, it is only capable of identifying and solving deterministic problems (known objectives) in the real world, thus, having known answers and classifying choices of existing knowledge, and it cannot dealing with uncertainties (unknown objectives) and dynamic intrinsic and non-axiomatic logic problems. From the mathematical point of view, it simply represents various deterministic problems as convex optimization problems and how to solve them more efficiently.

At the same time, Herbert Simon, in his book "The Sciences of the Artificial"34, suggests that an intelligent system needs six functions: input, output, store, copy, build symbol-structure and conditional transfer. This hypothesis is valid at the level of perceptual intelligence, but not at the level of cognitive intelligence. The reason is simple: it has no intrinsic "emergence", which is the intrinsic mechanism (force) that generate self-awareness. It is also a passive program execution model, not a cognitive system with endogenous self-awareness and meta-cognition functions (biological perspective: life system). In other words, information systems solve what the real world is; cognitive systems solve why it is.

From the perspective of the research paradigm of artificial intelligence, the research of machine consciousness in this paper belongs to the category of cognitive dynamics. It includes cognitive psychological model, dynamic model, topological model and so on. Among them, the mathematical basis of machine consciousness, that is, the mathematical category of cognitive computing, includes fiber plexus theory, homotopy theory, algebraic topology, differential topology, dynamic system, function theory (harmonic analysis), number theory and algebra (Lie group), and so on. At the same time, it covers a variety of mathematical physics (quantum computing, fluid mechanics, Fourier optics, engineering mathematics, condensed matter physics, etc.) methods.

From the point of view of system engineering, the machine consciousness device involved in this paper is the kernel part of cognitive system. It is aimed at the endogenous self-awareness of the machine and the mechanism of machine meta-cognition. The fundamental feature of cognitive system is the evolution of space-time situation based on cognitive computing and stream computing. Cognitive computing attributes: language package and space-time pool; stream computing attributes: it is different from the traditional information system data processing mode, it is an event-driven mode above the stream data processing of information systems. The caching mechanism of information stream is to use a double-ring linked list structure (intrinsic information real-time information); the parsing mode of information stream includes partitioning, grouping and partitioning; the computing model of information stream is also an extension based on the boundary, sliding window and attenuation model of stream data, extending from clustering model to subordinate, association and scale model.

The machine consciousness component involved in this paper is the kernel part of cognitive system. It is aimed at the endogenous self-awareness of the machine and the mechanism of machine me-

ta-cognition. In cognitive systems, information stream can also be called the event stream. From the point of view of cognitive intelligence, the features of cognitive computing model of cognitive system are language pack and space-time pool. The fundamental feature of cognitive system is the evolution of space-time situation based on cognitive computing and stream computing.

Cognitive Computing Structural Properties of Cognitive System

The three properties of language package: Eigenstate, Space-Time State and Mirror State.
Eigenstate: The structural ties of information stream.
Space-Time State: The transmission frequency of information stream.
Mirror State: The dynamic balance of information stream.

The four properties of space-time pool: Context, Scale, Topology and Orientation.
Context: The density rate varying with time and space.
Scale: The focusing effect varying with space.
Topology: The pulse trajectories varying with time.
Orientation: The opening and closing nodes vary with time and space.

From the biochemical point of view, the above cognitive computational structural attributes are similar to a biochemical semaphore: Pheromones, also known as pheromones or exogenous hormones, which have communication and guidance functions. The "information enzyme" (i) mentioned in the relative space-time theory (space-time equation: $S = iT$) in this paper exists in the form of "language package" in cognitive system.

Cognitive Algorithm Library and Framework of Cognitive System

In this paper, only the logical connotation of the cognitive algorithm library and framework is briefly mentioned, and the specific algorithm content will be described in another paper. In a nutshell, the cognitive algorithm library refers to the mathematical algorithm set of causality and energy models, which includes emergence algorithm, context algorithm, hierarchical algorithm, loop algorithm, periodic algorithm, the centre of gravity algorithm, symmetric algorithm, causal-effect algorithm, energy sub-algorithm and pulse algorithm. The constitutive equation of cognitive algorithm is nonlinear, of course, the framework of the algorithm must also be based on the "Tri-state Logic" model. The next step in the future is to construct the modelling framework of cognitive system --- the space-time-oriented visual modelling illustration language based on a space-time conceptual model, which is similar to the object-oriented Unified Modelling Language (UML).

"Machine Consciousness" Modelling 3

Suppose a "kindergarten" thought experiment, machine consciousness device (humanoid) has the ability to recognize the children and their friends playing around, and can make hugging or avoid-

ance behavior by itself independently. During the experiment, real children could not tell which one of them was a robot. The purpose of "Kindergarten" thought experiment is to verify the existence of machine consciousness.

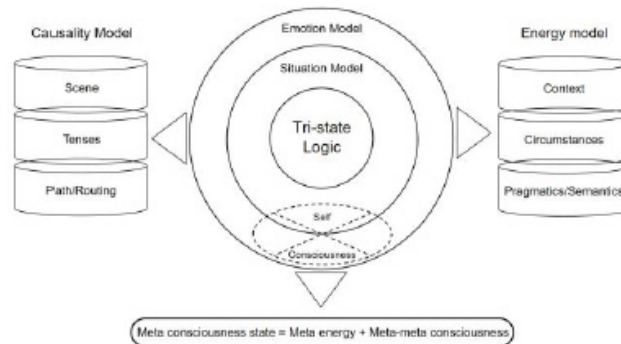**Conceptual Model Diagram of Machine Consciousness Device**

Figure 12: Conceptual Model of Machine Consciousness Device

Machine consciousness device (See Figure 12 above) is the core component of machine intelligence. Unlike the mechanism of machine learning on the level of perceptual intelligence, the first step in the level of cognitive intelligence is to build the component with machine self-awareness --- Machine Consciousness device. (Machine Thinker Device and Machine Behavior Device will be written separately.) The basic kernel layer of machine consciousness device is supported on the situation model based on the Tri-state Logic.

Logic Model Diagram of Machine Consciousness Device(See Figure 13 below):
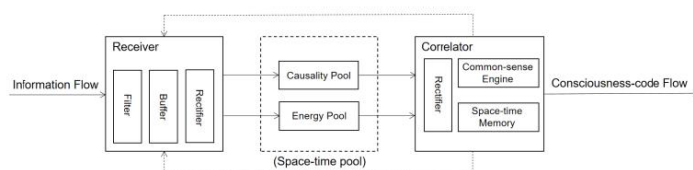

Figure 13: Logic Model Diagram of Machine Consciousness

Logic Connotation:
- Three Elements: Situation Model, Causality and Energy Preconditions, Common Sense Model.
- Three Functions: Match, Loop, Emergence.
- Three Characteristics: Match and Loop Symmetry, Causality versus Energy, Emergence of Machine Consciousness.

Operational Mechanism: when the situation model is combined with the causal precondition, the matching is generated; when the situation model is combined with the energy precondition, the loop is generated. Matching and loop formation are relative and reversible. Next, matching and positive-negative neutrality loop

feedback are coupled with common sense libraries to generate the emergence of machine consciousness.

The function layer of machine consciousness device consists of A + B () function models:

A () --- meta conscious device model (direct stimulation, indirect stimulation, idle);

B () --- causality model (sense, tenses, path routing), energy model (context, circumstances,

pragmatic semantics), emotion model (opposites, similarities, attention), space-time memory model (events, text pictures, audio and video), common sense model (parochialism, conservatism, extremeness|equivalence, similarity, repetitiveness).

The Function Model Diagram of Machine Consciousness Device(See Figure 14 below):
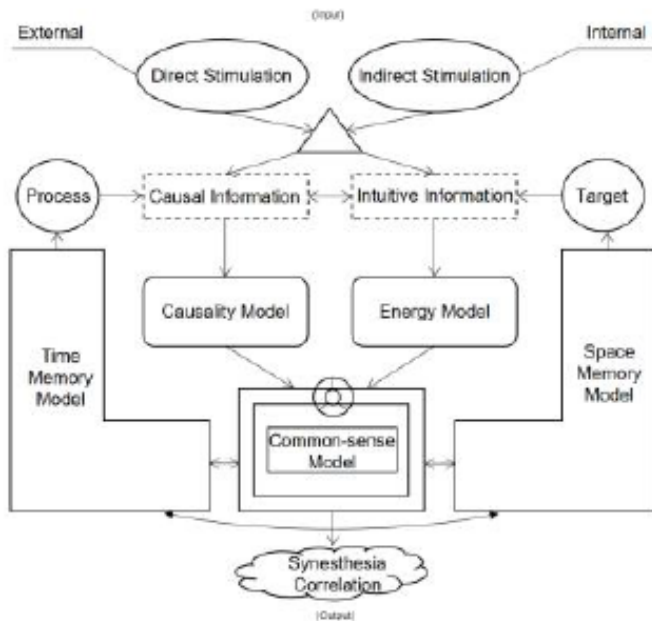
Figure 14: Functional Model

From the functional point of view of machine consciousness device, input to output is a closed loop with cyclic feedback information. Through the direct and indirect stimulation input, as well as the label mechanism of continuous time stamp and space stamp, combined with the surge of meta consciousness generator (Δ), and then through the communication and interaction with causality, energy, memory, common sense and emotional containers, the information output of synesthesia correlation finally emerges. Among them, the central scheduling model (⊚) is responsible for the matching and mobilization of exclusive emotions, the wake-up stimulation of specific space-time memory, and so on. It includes the conscious air switch, focusing and scaling mechanism, and enhancing synergy mechanism.

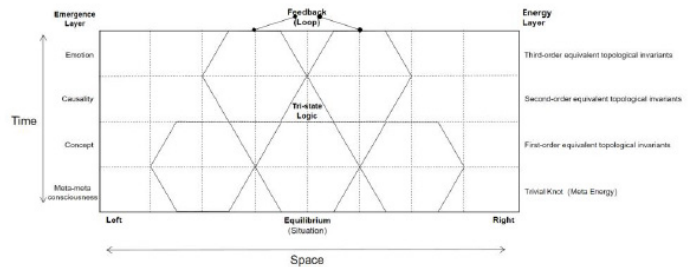## A. Hierarchical Model of Meta-Consciousness Generator

Figure 15: Hierarchical Model of Meta-Consciousness Generator

Meta-consciousness generator (See Figure 15 above) is a meta-consciousness state construction container (constructor) based on "Tri-state Logic" ontology equation and situation model. In the operating mechanism , it is similar to the fore brain island region function of the human brain35, the area of the anterior insula plays a gating role in the process of sensory information entering consciousness. There is a gradient functional level from single-mode sensory information processing (such as vision, hearing, touch, etc.) to multi-modal information integration (such as abstract thinking, advanced cognition, decision-making, etc.). The anterior insula is in the middle hub of this functional level. On the one hand, it receives single mode sensory information, filters and prioritizes it, on the other hand, it regulates the switching of two important brain networks, and allocates attention and cognitive resources for consciousness processing. The meta-consciousness state produced by it is a digital analog state intrinsic to the "Tri-state Logic". Its intrinsic model is shown as follows(See Figure 16 below):
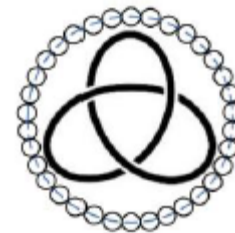

Figure 16: Intrinsic Model

From condensed matter physics, we know that a topological phase has the characteristic that when a column of waves (e.g. an electronic wave function) moves around a topologically extraordinary path, it will obtain a phase after completing the closed loop, rather than returning to the initial state, and its local dynamic excitation, that is, the emergence at the system boundary, is stable even in the case of defects. In other words, the polarization and transition characteristics of the topological phase are topological in nature, and they both have band structures with eigenvalues and eigenvectors. The so-called "excitation stability" is a topological invariant, which characterizes the band structure of the topology.

From the point of view of topology (knot theory), meta-consciousness modeling is a hierarchical model with topological properties. The degree of complex chains in a knot represents a hierarchical change in energy. The modeling process is an internal self-decon-

struction of the topological structure and topological relationship of the initial space, and a high level of topological morphology, topological structure, topological relationship and topological properties emerge from it. In other words, first of all, the initial input information at the perceptual level is topologically transformed and integrated to form the meta-consciousness initial state of the meta-consciousness generator: that is, to form a primitive ordinary knot (meta-energy). In the second step, using this ordinary link ring as the base state, and then matching the topological form and topological structure of the subsequent input information, through this process an initial conceptual form is generated, that is, a composite topological structure (first-order equivalent topological invariant).

The second process is to deepen the concept: the original conceptual form makes a second-order equivalent topological invariant by extracting and synthesizing the state features (energy enhancement) at this second level, which results in a second-order topological relationship. The meta-consciousness generator decomposes this second-order topological relationship to form a relatively stable sequential structure, causal state diagram, and then gradually produces other forms of composite relationship from causal state, that is, causal effect. The causal state diagram describes a causal invariance structure of the input information, this invariance is generated by the invariance of the topological relationship which comes from the set of equivalent classes of the information. The composite state produced in the structure of causal state diagram describes the invariance of the composite topological relationship, that is, the invariance of the second-order equivalence relationship and the invariance of the logical relationship.

After these two processes, in the third process, a higher level of meta-consciousness concept (third-order equivalent topological invariant) emerges from the meta-consciousness generator, which forms a new higher-order topological energy body. Through the transformation of the circulation loop mechanism and situation of continuous energy activation, the intuitionistic consciousness feedback(positive-negative neutrality) of the meta-consciousness generator itself to the information is formed, that is, emotion. Then, going up, you will enter a higher level of rational thinking with certain abstract concepts (omitted). Operating Principle Diagram of Meta-Consciousness Generator(See Figure 17 below):
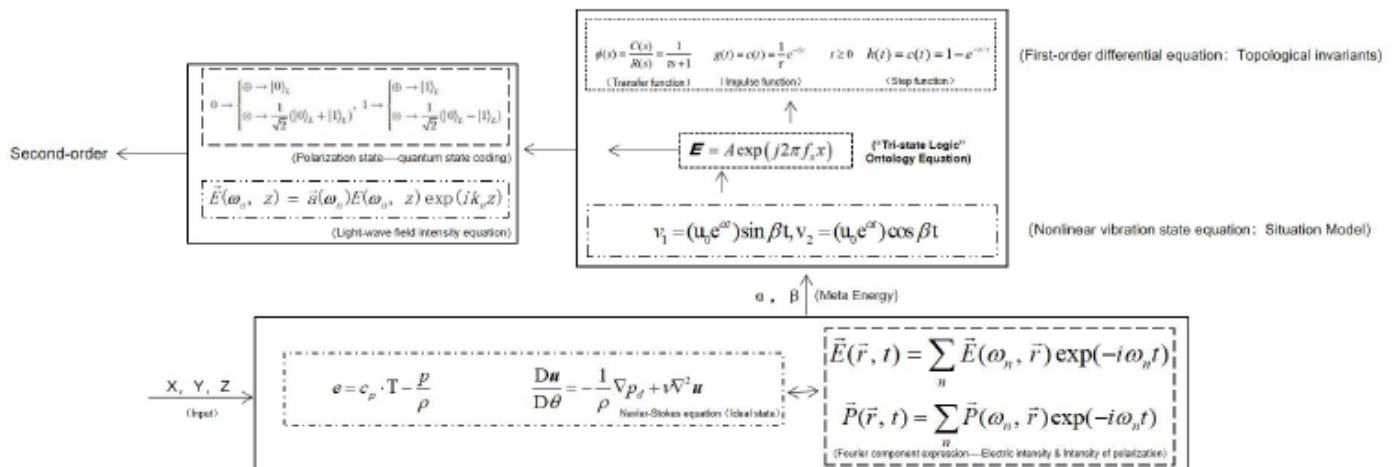

Figure 17: Operating Principle Diagram

Consciousness Field Generator

By using the language of differential geometry and quantum fluid mechanics, the fiber plexus is established on the mathematical manifold, and the cross section space on the fiber plexus is what we call the field of consciousness. Note: An equation of motion describing the momentum conservation of viscous incompressible fluids (N-S equation for short)[36] is introduced at the same time. It is a nonlinear partial differential equation. Ideally, the N-S equation can be simplified to the Euler equation in the ideal flow:

$$(axD + bxD + c)\, y = f(x) . \tag{8}$$

The variables of momentum accumulation (x, y, z direction) and flow (x, y, z components) are input externally[37]. This creates a meta-consciousness state (constructor) based on different "meta meta-consciousness generators" ("situation models" (expansion, contraction, equilibrium)). In other words, the consciousness field is a group of different vortex knots formed in the bottom manifold (the consciousness fluid). According to quantum fluid mechanics, there are large and small vortices, and many small vortices can be nested in large vortices. The same is true of the conscious field, where a large conscious fluid is nested by many small conscious fluids.

The field of consciousness is denoted as:a

$$\psi_\mu^a = \psi_\mu^a (x^1, \cdots, x^n), \ \mu = 1, \cdots, n; \ a = 1, \cdots, dim\ G, \quad (9)$$

where *dim* G is the dimension of the corresponding structural group.

In order to be associated with quantum mechanics and further with topological fluid mechanics, and to conform to the conventions of general electromagnetism, the field of ψ is simply a complex scalar,

$$\psi = \psi (x^1, \cdots, x^n) \in \mathcal{C} \quad (10)$$

this ψ is the wave function in the sense of quantum mechanics in the Schrodinger equation; under the Gross-Pitaevskii Equation (GPE), it is the condensed state wave function of electrically neutral quantum fluid (such as superfluid 4He), that is, the sequence parameter; and under the Ginzburg-Landau Equation (GLE), it is the condensed matter wave function of a charged quantum fluid (superconducting).

Next, we use the fluid mechanical formalism of quantum mechanics to construct the velocity field of quantum mechanics or quantum fluids in order to connect with the theory of topological fluid mechanics.

$$u = u (x^1, \cdots, x^n) \quad (11)$$

Where u is the velocity field, which is a vector field.

Fluid mechanics representation in quantum mechanics:
The electrically neutral quantum superfluid satisfies GPE, which is a nonlinear Schrödinger equation

$$\frac{1}{i}\partial_t\psi = \frac{1}{2}\nabla^2\psi + \frac{1}{2}(1 - ||\Psi||^2)\psi \quad (12)$$

Perform Madelung Transformation

$$\psi = \sqrt{\rho}e^{i\theta} \quad \sqrt{\rho} \text{ --- Mold Length,} \quad \theta \text{ --- Phase Angle} \quad (13)$$

then the density field and velocity field can be constructed

$$\rho = ||\psi||^2, \ u = \frac{1}{2i}\frac{1}{\psi*\psi}(\psi * \nabla\psi - \nabla\psi * \psi) = \nabla\theta, \quad (14)$$

this leads to Formalism. The original GPE is transformed into a fluid continuity equation plus a motion equation, similar to Euler equation or Navier-Stokes equation:

$$\begin{cases} \partial_t\rho + \nabla \cdot (\rho u) = 0, \\ \rho(\partial_t u + u \cdot \nabla u) = -\nabla\rho + \nabla \cdot \overset{\rightrightarrows}{\tau}, \end{cases} \quad (15)$$

$\overset{\rightrightarrows}{\tau}$

Where *T* is AND Vector, that is

$$\begin{cases} \partial_t\rho + \frac{\partial}{\partial x^i}(\rho u^i) = 0, \\ \rho(\partial_t u^i + u^j\frac{\partial}{\partial x^j}u^i) = -\frac{\partial}{\partial x^i}P + \frac{\partial}{\partial x^j}\tau^{ij}, \end{cases} \quad (16)$$

where $P = \frac{\rho^2}{4}$ is the pressure, $\tau^{ij} = \frac{1}{4}\frac{\partial^2}{\partial x^i\partial x^j}log\ \rho$ is quantum stress. The singularity ´p of the wave function appears at the position of density ρ = 0, that is , the place where the distribution of material field is zero. It is mathematically expressed as a generalized function, the Dirac δ function,

$$\delta(\sqrt{\rho}) = \begin{cases} 0, \text{ if } \sqrt{\rho} = 0, \\ \infty, \text{ if } \sqrt{\rho} \neq 0. \end{cases} \quad (17)$$

The position of density ρ = 0 is a singular line, which corresponds to the position of the vortex line. If these vortex lines are closed curves, the fluid vortex knots are formed; depending on the way of closure, the knots formed can have different topologies.

In the theory of topological fluid mechanics, the core is the concept of Helicity:
H = ∭Ω u · ω d³x, Ω --- The branch set, which is the domain;
∂Ω ---- Ω boundaries (18)

where the vorticity ω = ∇ × u, satisfies the condition of not flowing out of the boundary,
ω . n̂ = 0, where n̂ is the normal direction of the ∂Ω boundaries.

Liu-Ricca believes that it is a differential homeomorphic invariant, which is directly related to the topological number of fluid knots and is the most important topological invariant38. In other words, it is the Chern-Simons action whose structure group is Abel group, that is, using the idea of Chern-Simons topological quantum field theory to construct the fluid knot polynomial based on the helicity.

As topological excitation, knots has relatively strong robustness; however, it is not absolutely stable, with the irreversible dissipation of energy, it will degenerate from complexity to simplicity, until mediocrity and disappear. Liu, Ricca and LI pointed out that when there is no external interference, the knot complex system will degrade and dissipate spontaneously in the way of cascade degradation39. The degradation process may choose different paths, among which the shortest one has the greatest probability of occurrence. At the same time, from textbooks in the field of turbulence, we realize that large vortices are the source of energy, and small vortices are responsible for energy dissipation. The large scale vortexes obtains energy from the outside and output it to small scale vortexes. The small scale vortex is like an energy-consuming machine, which dissipates all turbulent kinetic energy into heat energy. The inertia of the fluid is like a transmission machine, which transfers the energy of the large scale vortex to the small scale vortex continuously. In short, our aim is to label and identify knots with sufficient topological invariants, and then implement knot coding, knot resolution, knot maintenance, and knot reconnection within the framework of computer algorithms.

Meta Meta-Consciousness Generator

The initial state of meta meta-consciousness is a continuous minimum energy (ring) state (a trivial knot), specifically, the situation model based on "Tri-state Logic" seamlessly docks with the solution of the output equation of the Field of Consciousness Generator(FCG).

Nonlinear vibration equation:

$$v_1 = (u_0 e^{\partial t}) \sin \beta t, \quad v_2 = (u_0 e^{\partial t}) \cos \beta t \qquad (18)$$

Among them, equilibrium points can be divided into two categories, that is, stable equilibrium points and unstable equilibrium points. The difference is not in the state of the equilibrium point itself, but in whether the system tends to move back to the equilibrium point, keep moving near the equilibrium point, or move further and further away from the equilibrium point when slightly off the equilibrium point. Accordingly, the equilibrium point is divided into progressive stability, only stable or unstable, in which the first two equilibrium points are also called stable equilibrium points[40].

The situation model corresponding to the "Tri-state Logic" is the dynamic expansion, contraction and equilibrium state.

Solution of Ontology Equation of Tri-state Logic

Meta meta-consciousness is the changing trend of the frequency and amplitude of the vibration in the process of continuous and autonomous machine perception (external-internal / direct-indirect stimulus). It consists of a time dimension (dominant frequency) and a space dimension (dominant amplitude), respectively. In the time dimension, frequency denotes the logical "1" state, and no frequency denotes the "0" state; in the space dimension, amplitude denotes the logical "1" state, and no amplitude denotes the "0" state. In the implementation of the algorithm, it is the conversion from real space to frequency space, and the core is Fourier transform.

The classification and location information stream of "human and animal" input from the outside information is converted to the logical "0" and "1" states respectively, and the number of prime junction crossings, then the number of prime junctions corresponding to the number of prime junction crossings is reclassified. Next ("human" is a flow of information; "animal" is a flow of information) through the arrangement and combination of N sets of 8-bit quantum error correction codes to output "0" and "1" respectively, the Tri-state Logic ontology equation ($E = A\exp(j2 \pi f xx)$) combined with the output equation solution of the meta-energy generator is used to derive a continuous meta-consciousness (2-way) binary situation flow.
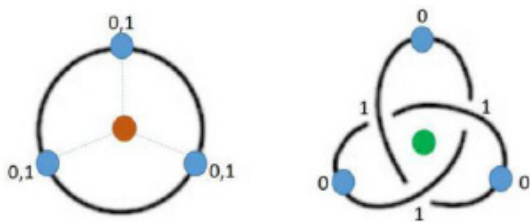

Figure 18: Tri-state Qubit.

Based on the long-existing braid group (braid matrix) and the correlation model of the knot theory, as well as the theory of topological quantum computing, we can formally regard knot quantum computing as an extension of quantum error-correcting code[41] similar to conventional quantum computing[42], rather than just using quantum error-correcting code to correct errors. The left diagram (See Figure 18 above) is the eigengraph of the "Tri-state Qubit", which contains three "Tri-state Quantum Bits", at some point, they are in one of the three states of uncertainty and are located on the equidistant points of the circumference. These three entangled and dual "physical" quantum bits are encoded into a "logical" qubit corresponding to a space-time point (brown point) in the center of the circle, which is a quantum fixed point. The right diagram is the ontology diagram of "Tri-state Quantum Bits", which contains two groups of three "Tri-state Quantum Bits" representing the determined possible states "0" and "1" respectively, "0" being the middle point of the line between the two "1", and "1" being the junction of the two lines. The space-time point in the middle (the green point) is the duality of the states "0" and "1". Clearly, the space-time points of the left and right diagrams are coincident, that is, the center points are consistent (symmetric).

Using the conceptual symbols of photon polarization for reference, two new types of graphical symbols are given:$\|$ and $\_\_$, the front one represents "0" ("nothing") and "1" ("have") of the frequency; the back one represents "0" ("nothing") and "1" ("have") of the wavelength.

Quantum computing told us: 1 quantum bit has 21 states, 2 quantum bits have 22 states, 3 quantum bits have 23 states, n quantum bits have 2n states. In the other words, one register of 3 quantum bits (made up of 3 atoms) can store 8 atoms (010>110>000>100>011>111>001>101>).

The consciousness logic gate in Meta Consciousness Generator is learning from the logic gate [CCNOT (Controlled-Controlled-NOT gate)] mode that operates on 3 quantum bits in quantum computing. Its characteristics are as follows: if the first two quantum bits are |1>, then the third quantum bit is treated with a logic not gate similar to the classical one, otherwise, do nothing. The first two quantum bits are operators, the third one is observer. Logical gate group is composed of n logic gate, so we can say that the machine consciousness stream is generated.

Each quantum state is encoded and the corresponding relationship between the polarization state and the message sequence transmitted to the quantum channel is:

$$0 \rightarrow \begin{cases} \oplus \rightarrow |0\rangle_L \\ \otimes \rightarrow \frac{1}{\sqrt{2}}(|0\rangle_L + |1\rangle_L) \end{cases}, \quad 1 \rightarrow \begin{cases} \oplus \rightarrow |1\rangle_L \\ \otimes \rightarrow \frac{1}{\sqrt{2}}(|0\rangle_L - |1\rangle_L) \end{cases} \qquad (19)$$

Where $|0\rangle_L, |1\rangle_L$ is the logical state, thus, the encoded polarized state[43].

B. Causality Model (sense, tenses, path routing), Energy Model (context, circumstances, pragmatic semantics), Emotion Model (opposites, similarities, attention), Space-Time Memory Model (events, text pictures, audio and video), Common Sense Model (parochialism, conservatism, extremeness|equivalence, similarity, repetitiveness)

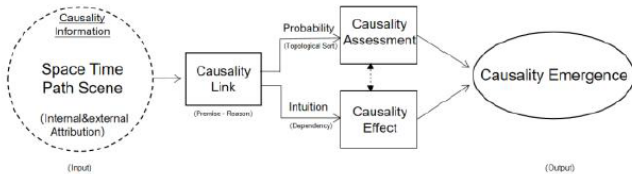**Causality Model (sense, tenses, path routing):** (See Figure 19 below)

Figure 19: Causality Model

The causal information stream at the input includes

- Time: real or non real moment (time stamp: interval limit).
- Space: topological phase transition (space stamp: nonlinear polarizability).
- Path: topological sort (bearing stamp: linear sequence).
- Situation: event situation (event stamp: rejection-attraction-steady state).

Causality is divided into linear causality and nonlinear causality. Linear causality is judged by probability (timing of associated events), that is, topological sort, at the same time, we use Dehaene's global neural workspace theory28 to classify the types of self-consciousness based on the results of probability calculation; nonlinear causality forms causal effect by intuition (coupling of non related events), that is, topological phase transition. The parallel evolution of the two modes produces causal emergence functions (separate --- approximate --- neutral).

Energy Model (context, circumstances, pragmatic semantics): (See Figure 20 below)
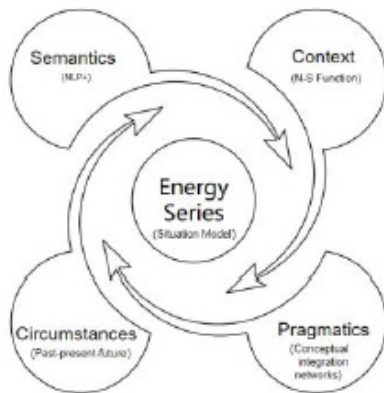

Figure 20: Energy circle of consciousness

From the point of view of energy aggregation and transformation, conscious energy is a multi level, continuous spiral loop, the center point of the ring is the focal point of energy and the center of gravity of energy, which represents the main excitation point of conscious energy. To expand a little, consciousness energy, thinking energy and behavior energy are three nested concentric circles. From the static hierarchical point of view, the conscious energy circle is in the innermost layer, followed by the thinking energy circle and the behavior energy circle. The center point of the circle is the center of gravity of the energy circle. From the knot theory, the more the number of knots around, the higher the energy level.

The central circle of consciousness energy circle is the operation of situation model. Among them, the expansion degree of situation model represents the degree of aggression and extroversion; the contraction degree represents the degree of autism and introversion; the equilibrium degree represents the degree of stability and friendliness. The inner ring of consciousness energy circle represents "energy level"; the four outer earrings represent the four relevance attributes: voice, pragmatics, semantics and context, which simultaneously contain the corresponding time stamp, space stamp, location stamp and event stamp.

Here, we also need to use the classical picture in quantum mechanics to the quantum picture represented by wave function and energy spectrum, whose bridge is the quantization condition, $[x, p] = i\hbar$, that is, the numerical characterization of the energy spectrum in a given coordinate system is also independent of the scale.

From the mathematical point of view, the expression of space-time ontology of consciousness energy level is based on the ontology equation of Tri-state Logic:
$E\ Aexp(\ j2\pi\ f\ xx)$. The input of consciousness energy level is the above four attribute variables, and the output is the corresponding energy level.

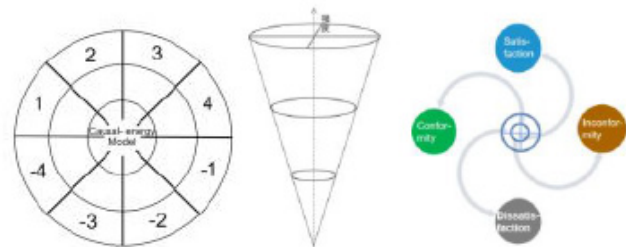**Emotion Model (opposites, similarities, attention)**

Figure 21: Emotion Model --- Motivation Model

The emotion model (See Figure 21 above) refer to the book "Theories of Emotion"44 by R. Plutchik, an American psychologist, its sharp is similar to an inverted cone, and the kernel is the causality-energy model. The eight sectors of the innermost ring on the cross section of the cone represent eight basic emotions respectively; the eight sectors of the middle ring represent 24 kinds of

complex emotions; the eight sectors of the outermost ring represent the associated attention emotions. The adjacent surfaces of the eight sectors have a certain degree of similarity. The Arabic numerals: 1|-1, 2|-2, 3|-3, 4|-4, representing the opposite of emotional indices. The emotion is a kind of energy, and also a kind of frequency.

The distance between the bottom tip and the top surface of the cone represents the degree of emotional intensity from weak to strong, which is determined by the energy level of the energy model. The emotional orientation of the inner and outer ring of the transverse tangent of the cone is determined by the emergence function(See Figure 22 below) of the causality model. The emotion model has an associated motivation model built in.
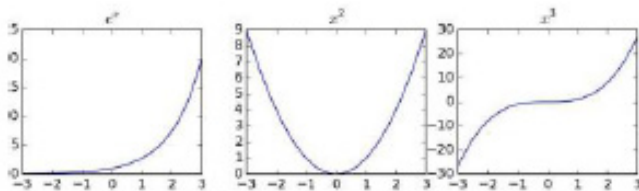

Figure 22: Energy Level --- Emerging Function.

Space-Time Memory Model (Events, Text Pictures, Audio and Video)

Based on the knot-quantum computing model described above, the eigenbody of a stream of consciousness code is a set of knots in a particular topology. In the space-time memory model, while storing the emerging knot set, the topological feature of the knot set, namely the topological number or topological invariant, is also stored synchronously as an index. The space-time memory model (see Figure 23 below) exists in the form of memory map. The structure of the memory map refers to the twelve equal rhythm pattern of music45. Eighth tones are divided into twelve equal parts, each part is the frequency ratio of half tones, the twelfth root of two:

$$\sqrt[12]{2} = 2^{\frac{1}{12}} \approx 1.059463.$$

The relationship between time memory pool and space memory pool is derived from
meta-space ontology equation: S = iT .

The space-time event stamps and situation information in the memory map are stored in the time memory pool and the space memory pool respectively in the way of three-dimensional code, which is combined into a complete event + contextual memory stream code.
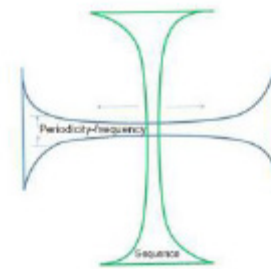

Figure 23: Space-Time Memory Model

The stream of consciousness code is a combination of molecular biology46 DNA identification method and three-level structural mode(The helices of the two DNA strands cross arrange an ordered strand with complex topology, that is, knot property). The three-level structure represents the space-time state of everything: past, present and unrealistic. Level One Structure: a stream of consciousness code simple sequential Chain.(Time |Space) Level Two Structure: two streams of consciousness codes simple sequential Chain.(Time + Space)

Level Three Structure: two stream of consciousness codes complex topological sequential chain.(Folding Time and Space)

The stream of consciousness code storage of the above three-level structure is completed by De Bruijn sequence.

Mathematical Expression:
B(4,3) sequence length 64
[Note: De Bruijn sequence pattern:
Sequence: B (k, n), a cyclic sequence consisting of k elements. All k-element constituent sequences of length n occur in their subsequence (in ring form) only once. The length of the sequence is the n-th power of k]
The core part is a DNA Mobius loop model based on energy model, among them, the memory space state of the past and the present is distinguished by the chirality of the left and right rotation of the Mobius ring (cross storage).

Common sense model (parochialism, conservatism, extremeness | equivalence, similarity, Repetitiveness)

The common sense model (see Figure 24 below) exists in the form of a common sense map. The structure of the common sense map is a reference to the natural cellular structure, which is stable and hierarchical. The natural attributes of the common sense map are divided into three dimensions: personal, social and scientific. The information attributes of common sense maps: space stamp, orientation stamp, event stamp, and time stamp. Among them, personal attributes contain a role transition state: self, alter ego and id. This is a nested role state, that is, a role transition state corresponding to the relevant context.
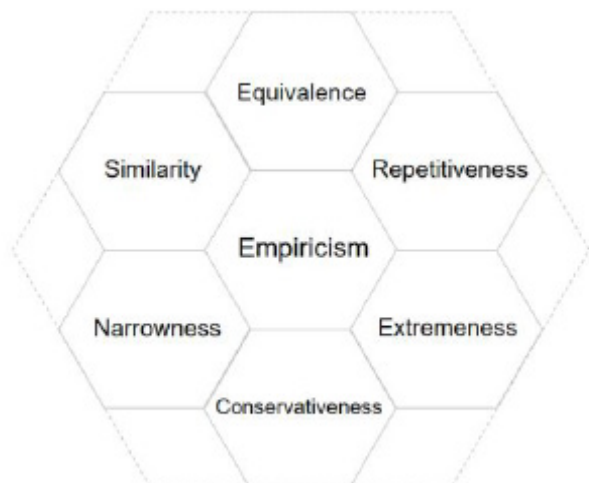
Figure 24: Common Sense Model

Its computational mathematical model is based on the response surface algorithm in material science47, by modeling the natural frequencies of cellular topology, the topology model variables are established, and a second-order natural frequency table is established for the frequency response characteristics of the structure, and the variable coefficient matrix is established, and the variable coefficient matrix is established. At the same time, the model is optimized by multi-objective and multi-level according to genetic algorithm, where "empirical" exists as a growth function.

The output of common sense model is several conformity functions.

Concluding Remarks

The 20th century is the era of disciplinary differentiation and professional development, and the era of scientific reductionism and determinism. The resulting artificial intelligence computational and perceptual intelligence has also evolved based on random theory of probability and statistics.

The 21st century will be an era of interdisciplinary integration and multicultural integration, and the era of logical system theory based on the first principle of complex cognitive structure, or can be called post-phenomenological era48. The cognitive intelligence of artificial intelligence will also develop based on the meta-level Theory of Tri-state Logic.

According to the "paradigm" in Kuhn's "The Structure of Scientific Revolutions"49, we are creating a new "paradigm of cognitive scientific computing" and a meta-cognitive logic system.

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