

The Central Idea of the Philosophy of Computer Science

—— the Instruction of Research on Philosophy of Computer Science ¹

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Abstract: The basic spirit of Pythagoreanism is the pursuit of the mathematical harmoniousness of the universe, and it can guide scientists to characterize the internal mystery of the physical world in terms of mathematical language and mathematical formula successfully and it fit to the current computationalism. On the other hand, re-understanding natural views of teleology by means of the modes of system science can interpret the biological universe, the artificial life and the universe of self organization reasonably. We insist that the integration of the pythagoreanism and the natural views of teleology will constitute the central idea of the philosophy of computer science.

Key Words: The philosophy of computer science; The pythagoreanism Computationalism; The natural views of teleology; The universe of self organization

As time goes on, it has nearly been ten years since we entered the 21st century. In the past 20th century just now, the most rapidly developed discipline, which also has the most influence to people, undoubtedly is computer science and information technology. And now, computer has already been a kind of symbol of the new century. As A · W · Burks, the American computer science philosopher and the professor of Michigan university, says that the only request of entering the Platonic Academy which is the first advanced research institute of the western is “Let no one ignorant of geometry enter”. In the future, a plenty of universities will request that students bring computer when entering. Therefore, the new type Platonic Academy’s command should be “Let no one ignorant of computer and without computer enter”. Philosophy is the centralized reflection of the age spirit, the rapid development of computer science and information technology will lead to the philosophy paradigm’s transformation for sure. Thereby, a new research field will be founded, and a new creative research guiding principle will be raised. And then the new paradigm will become the new method to solve traditional philosophy problem. The transformation of this kind of paradigm is “Computer Revolution”^[1] or “Information Turn”^[2]. The directly result of the transformation causes the emergence of computer philosophy of science. Philosophy of computer science belongs to this new paradigm and research guiding principle.

Philosophy of computer science is not only a new philosophy thinking under the background of computer and net technology’s rapidly developing in information age, however, specially pointing, but also the inherit and development of the two traditions mathematics natural view of pythagoreanism and Aristotle’s organism or the natural views of teleology.

The fundamental creed: the integration of mathematics natural view and the natural views of teleology.

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We have proposed that, in the work *the Headstream of Thought of Science*^[3], the natural philosophy of ancient Greek leaves thought estate for recent science and philosophy of science, and it can eventuate in three traditions “atomism” “mathematics natural view of pythagoreanism” and “organism or the natural views of teleology”. The thought of atomism and pythagoreanism tradition^[4] exerted a great effect on the foundation of recent science, however, purposivism natural view was excluded out of science in long time, and it resurrected science system science rose in the middle of the 20th century.

It will be very distinct about pythagoreanism tradition and its affect in the history of science thought in follow lists:

Galileo's sayings should be considered as the declaration of pythagoreanism: the great work of universe is written by mathematics language, and its character is triangle circle and the other geometrical graphs.

The discovery of Kepler's three laws of planet should be considered as the victory of pythagoreanism, but not the only victory of induction. The pursuit of the mathematical harmoniousness of the universe, actually, caused that Kepler successfully used mathematics language and formula to represent the rules of physics world.

Weisskopf said that Pythagoras view was regenerate in spectrum line of hydrogen atom, "astronomical euphony" revived in atom world.

Heisenberg pronounced that the particle of modern physics is just about a kind of mathematics abstract of elementary symmetry.

The basic principle of universe programming is to seek the inner symmetry and the harmony beauty.

Superstring is the chord of the universe, the chord of the nature and the chord of pythagoreanism.

Additionally, there is physics actuality's support at the back of mathematics structure. For this reason, we propose further, in the work of *Physics Philosophy Research of Gauge Field: Its Conception Foundation, History Development and Philosophy Connotation*^[5] and *Commentary on the Guiding Principle of Gauge Field Research: a Kind of Interpretation on Pythagoras Mode*^[6], the nucleus idea of our physical philosophy research principle is to integrate the two idea pythagoreanism and science realism. We are science realism, and deeply believe that science theorem of mature science theory represent the approximative truth of physics world. Neither particle ontology nor field ontology violates science realism. Meanwhile, we also believe that the elementary structure of physics world and the secret of its interaction are hidden deep in mathematics harmony, especially in symmetry: outer symmetry and inner symmetry. The latter idea is basic faith of pythagoreanism, and we just additionally explain that this mathematics harmony is not man-made but intrinsic in physics world itself, whereupon the pythagoreanism idea is integrated with science realism.

We both emphasize the special significance of re-understanding natural views of teleology by means of the modes of system science on interpreting the biological phenomenon, in the tractate *System Science: the Metatheory in the Back of Biology Theory*^[7], which is submitted in the international meeting of system science and establishment realism. We also advance that, in our co-author work *Philosophy of Biology Science*^[8], the whole secrets of the biology philosophy are in system science, as system science can be considered as the metatheory at the back of biology theory; the work emphasize again that the natural views of teleology in the field of view of

complicacy system science has a special value on understanding life representation.

Being traced to the above thought, in the work published imminently *Research on Computer Science*, what we insist is that **the integration of the pythagoreanism and the natural views of teleology will be the golden key to understand the secrets of the computer philosophy of science. It is the central idea of our new research guiding principle.**

the Duality Origin of Logic Machine

The modern logic machine thought of modern computer scientist Burks not only has the origin of pythagoreanism, but also can find the ground in Aristotle's teleology and thought of auto-machine, and, moreover, the thought unceasingly continue in history by getting help of plenty of philosophers' and scientists' wisdom.

The two authors' interest of computer artificial intelligence philosophy started off in about the year 1989. Then Ren xiaoming was working toward a Doctor Degree under the direction of professor Jiang tianji, and in those three years, he often discussed Burks' thoughts of inductive logic and logic machine with Gui qiquan. Our Doctor station of modern foreign philosophy was approved in the first batch by Chinese ministry of education, and there was Jiang tianji tradition in the fields of philosophy of science and analytic philosophy; it emphasized to grasp the sequence of ideas of narrow sense philosophy of science, researched meticulously representative schools characters works and thoughts, and kept objective, pertinent and undistortionless. Under the commander of Mr. Jiang tianji, Gui qiquan promoted departmentalized philosophy of science, insisted that integrated the narrow sense philosophy of science and science history, and applied the general principle of philosophy of science, the reasonable kernel, to research physics philosophy, biology philosophy, economy methodology and philosophy of computer science etc.

If tracing the history of science thought, it can be founded that philosophy of computer science actually originated pythagoreanism and Platonism. The basic idea of pythagoreanism was that number was root of all things. Mathematics harmoniousness, specially pointing to the mathematics symmetry, speaking in detail, was the essential nucleus about elementary structure knowledge of physics world, and it must seek the origin from the mathematics nucleus of nature discipline in the meaningful order of the nature. Science philosophers generally say that mathematics harmoniousness is a kind of strong luminous principle to help discover in the process of exploring science laws.

Modern computer science philosopher Burks interpreted, about the above view, that philosophy of computer science traced the reasonable elements from pythagoreanism and Platonism, but it must be revised two points, one was that what mathematics illustrated and described was the nature's form but not the content, and another was that mathematics was abstract, while nature was specific, which was composed by substance and substancians and dominated by disciplines and principles. Buiks developed the ancient Greek thought on the mathematics nature into a kind of view of modern computer mathematics. In his opinion, a computer was a logic machine which is composed by switch and program control storage hardware written by computer language. Then Burks applied the philosophy statement that number is the root of all things to human-beings and concluded that everybody had his own Pythagoras number which was involved two number strings that was the inborn hereditary program and the interaction between acquired innate elementary and circumstance. In another word, everybody had a natural function robot substitute which can realize his everything. Obviously, it is the modern edition of pythagoreanism.^[9] The philosophy term logistic mechanism

was first raised by Burks, the professor of computer and communication science department of Michigan University America, who was famous as not only a philosopher, but also a computer scientist. As a philosopher, he was a scholar on researching Pierce (Burks 1958), and also was one of the pioneers on causal inductive logic (Burks 1977); as a computer scientist, he was one of the major projectors of the first general computer ENIAC, and was one of the founders on structure cell automaton theory, too. He initiated the research on computer logical net and gave its logical project with White et al. This kind of was considered as a model by many universities, research institutes and computer companies.

The main idea of logical machine philosophy is that human is equivalent to finite decisive auto-machine; it can be explained by reductionism on human's unique ability, and how can the evolution process of this ability produce can be explained in logical machine. It mainly investigates the relationship among human society science and computer, research the relationship among computer and mind, evolution and intentionality, biology and auto-machine, and free will and determinism. However, its central thesis is whether a finite automaton can realize all of the natural functions of human or not. In another word, can a robot realize all of the natural functions of human? This is the thesis human is equivalent to machine.

On the other hand, logical machine philosophy also originates the natural views of teleology of ancient Greek. As we all know, the teleology has been hardly misinterpreted in science history and philosophy history. Therefore, we should restore it right. We will apply the view of complexity system science to discuss this thesis with large space in *Research on Computer philosophy of science*. In nature philosophy of ancient Greek, there were three thoughts, atomism, pythagoreanism and organism or the natural views of teleology, which still had been determining the developing route of modern science thoughts. Heisenberg has deeply analyzed the emphasis of the two formers in his work *Development of Strict Science in Recent Years*. But the focal point we focus is third thought. Since the middle 20th century, the natural views of teleology which had been buried for long revived in new conditions, because the complexity system science rising. Biologists and system scientists discovered in surprise that the natural views of teleology reinterpreted, Wiener's cybernetics which advanced all of the action of teleology essential are equal to action needed degenerative feedback for example, was still a research guide with strong inspiring power to understand the secret of self-organized universe. Thus, the natural views of teleology became jointly followed by philosopher and scientists.

The natural views of teleology, which was initiated by Aristotle, believed that the universe was an organic entity. The nature had potential purpose, which all things created suited purposes. It was a result of nature internal mechanism for the structure, function, program and action of living's conformity to aim. Changing another word, the conformity to aim of nature had nothing to do with god will, which was the essential difference between external conformity to aim and internal conformity to aim. It also considered that human, carpenter and architect for example, could imitate and reappeared the structure and function mechanism of nature by technology. Interestingly, Aristotle unexpectedly manifested the thoughts of auto-program and automaton in the process of proposing the natural views of teleology. He considered that the process of turning latency to reality should be a process of self-execution in the guide of preprogram. He repeatedly pointed that the process of the program automation of ooblastema growth resembled very much with the process of the program automation of a kind of automaton at that time. Ooblastema rose up hearts, lungs, livers, eyes and so according to the programming blueprint of cause of form,

which liked automaton that the wirepuller influenced the first one of levers, and then A drove B, B drove C, C drove D, D drove E and so on, and thus the machine acted like dancing by rhythm.^[10] It can be clearly be seen that Aristotle manifested that, in his metaphor language, ooblastema was a organism automaton which included reprogram of teleonomy which controlled the course of individual up-growth in future and determined its purpose in the end. Although Aristotle's automaton was specially a kind of simple automaton equipment, but it had the character of program, which manifested he had implicated the thought of modern automaton theory. Because Aristotle compared clearly the living and the auto-machine, we having to agree, it was involved in his thought with the sprout of artificial life theory.

Today with self-organization theory having developed flourishingly, people discover in surprise that the great philosopher Kant unexpectedly is a prophet of self-organization thought. Kant thought that the self-organization natural thing had some certain characters that its parts existed because of the function of other parts and, on the other hand, existed for the other parts and the entirety, and that its parts interacted with each other and produced with each other and the entirety produced because of the parts' causal connecting. "One product can be an organization and self-organization thing, only under the these conditions and according these rules, which can be a natural purpose"^[11]. He said, by setting an example, that a clock was an organized thing but not a self-organization thing, for its parts could not product, revive, repair by itself but a clockmaker. If contacting this thought with von Neumann's thought of self-revival auto-machine, we can find how great the inspiration of Kant's thought was. In Kant's opinion, self-organization is merely a reference of teleology. This thought, obviously, has great value to system scientists and has inspiration to manmade-life philosophy.

More interestingly, Hegel's famous dissertation of tricky rationality gained new meaning in modern self-organization theory. Hegel narrated, in his work *Logic* and *History Philosophy*, that history or rationality liked a tricky fox who pretended not to do any intervene and let everyone acted according to his own will, interconflictedly and interoffsetedly, and reached his purpose by using their struggling with each other.^[12] Actually, the tricky rationality is very similar with the order parameter which determine to the macroscopic order of system evolution in synergistic. Hegel's descriptions above are exactly like how order parameter guides the self-organization system to realize teleonomy description.

Actually teleology philosophy about the comparison between life and machine teleonomy gave a promotion to product the computer philosophy. Contrasting with teleology which was not attached importance in philosophy history, teleology and teleonomy issue have become a central thesis in biology science and complexity system science. System science developed from the middle 20th century (system science developed at the complexity stage later and the both together named complexity system science) deeply emphasized the nature science and philosophy society science. People started to use a kind new idea and viewpoint to consider the primal idea of philosophy and science. To the research on computer science, the greatest shock of new subjects was to reinterpret the superficial and heavily misinterpreted teleology and the evolution theory which was denounced to be frothy and tautological by using the view of system science. The result was that system science promoted biology science, philosophy of computer science and manmade biology philosophy to gain their autonomous position as a philosophy subject and built the root of biology science on the system science and complexity science.

Modern biologist E•Mayr discovered, on the basic of M•Delbrueck's research, that it can

abstract the thought of program teleonomy from Aristotle's teleology, which is the most valuable part of it. Mayr considered that program teleonomy can be demarcated as a type of acting process operating according to some program and information secret code, which involved two elements, one of which was guided by some program (equal to Aristotle's eidos, form cause or model theory), the other one of which was the type of process determined by the existence of the purpose reprogrammed by the program (equal to Aristotle's purpose cause).^[13]

It is a pity that Mayr recognized most deeply the relative contents of information code and control program only. (He rejected the work *General System Theory* and *Hyercycle Theory*, because they were too metaphysical.) Another biologist D•Hull comprehend the system theory more deeply. According to the originator of the system theory N•Wiener, all of the teleonomy actions were the actions which need negative feedback to control themselves. But Hull interpreted in success the phenomenon of natural living's teleonomy by using basic model of Wiener's control theory, self-stable function model (air-condition model) or teleonomy action (torpedo model), in his work philosophy of biology science. In our book, we exert Hell's thought, with the other new branches of system science, such as dissipation structure theory, synergetics, hyercycle theory and chaos theory to interpret more deeply the teleology.

Ludwig Von Bertalanffy, originator of general system, considered that teleonomy issue was just modern science issue, especially system science, which need treated seriously. He criticized the mistake which simply excluded the teleonomy from science in modern science. He also pointed out that teleonomy actions can be imitated, at least, with three theory models, equi-result model, feedback model of control theory, model applying in adaptive behavior.

The modern teleology philosophy developed in the ground of system science and complexity science, on one hand, inspired and affected self-reproducing automaton theory of von Neumann, and then took actively effects on the product of computer philosophy of science; on the other hand, under the influence of this teleonomy philosophy, Turing proposed Turing machine named by his name which was actually a kind of logical machine. The cooperator of von Neumann, Burks proposed the thought of evolution logic which developed logical machine philosophy from the aspect of logical mechanism and established the foundation of evolution logic theory in artificial life. It can be said that there is no philosophy of computer science without revivification of teleology philosophy. Therefore, our book discusses in detail the teleology and teleology issue in first section and the second section.

The product of Living teleonomy automaton theory and the thought of artificial life were inspired by the development from machanism mechanism to logic mechanism. The earlier machine, water clock and Jacks et al., and the later animal automaton both were a type of artificial life model in a form of machine. With the developing of mathematics logic in the early 20th, people started to explore the ability of abstracting the process of machine auto-control in form. The general computer produced with the developing of computer technology, programmable control technology and machine form theory. And the development of general computer promoted a lot of scholars to transfer their researches from life mechanism to life logic. Under this background, living teleonomy automation theory produced. The philosophy origin of this theory is pythagoreanism and the tradition of the natural views of teleology since Aristotle.

The expectation of people wanting to imitate life produced from the beautiful Greek legends, but emulating and imitating originated from the revival of pythagoreanism(the secret of the universe is mathematics harmoniousness) and the tradition of natural views of teleology(the

self-organized universe has the automation adjustment mechanism of a kind of teleonomy. In the year 1950s, von Neumann proposed automation with self-reproducing function; the same as Turing machine, the thought of von Neumann was inspired by computer neuroscience of McCulloch-Pitts. His self-reproducing automaton was actually a miniature of artificial life. The same as Turing, he was interested in the spontaneous order which produced because of complying simple rules. As a part of the work of cellular automaton, he also researched self-reproducing logic and discovered that giftedly the logical structure of self-reproducing automaton must exist in living cells. Not long after, Crick and Watson discovered the structure of DNA and proved von Neumann's conjecture. Compared with Turing's theory, his automaton theory was more similar with the actuality of living system. It was a pity that von Neumann died too early and could not construct the perfect theory. Burks and his team continued his uncomplicated work and obtained certain achievements. In the year 1970s, people recognized that von Neumann's theory had two defects: one was that it did not combine the actuality of biology, and the other was that it was limited in static research. So some computer scientists proposed molecular automaton model, computer logic system of living upgrowth, classifier system and inherited algorithm and so on which had actually the miniature of artificial life theory.

A nucleus view of logical machine philosophy which self-reproducing thought supported and established was that human was just a automaton or a logical machine; but logical machine philosophy on the comparison between human and robot undoubtedly inspired people to compare natural life with artificial life. So we can say that the works of von Neumann and Turing not only helped to establish the thought of logical machine philosophy, but also promoted objectively the birth of artificial life theory. The theory of biology automaton of von Neumann and Turing was not only the scientific and logical basic of logical machine philosophy, but also the miniature of artificial life theory. In the view of it, the third section of this book discusses the philosophy of biology automaton and logical machine. And the fourth section espounds the origin of artificial life theory.

Since the year 1980s, there raised a research upsurge of creating new life form by using non-biology medium in the world. This kind of new life form is artificial life. In the literal sense of the word, artificial life (AL) is manmade life, but not natural life. What researches on artificial life, as a research field, is artificial system with natural life system action. The essential of the research on artificial life is computer emulation and life imitation.

We divide, in the boundary of the year of 1987, the artificial life theory into the miniature of AL theory and proper AL theory. The miniature of AL theory was called in biology teleonomy automaton theory by some scholars, which represented by self-reproducing cell automaton of von Neumann and included as well L-system (1974) proposed by Aristid Lindenmayer which was a automaton logic system describing the form of life upgrowth and belonged to the research field of fictitious life. The later theory was classifier system and genetic algorithm. Since 1960s, J•Holland started to research the suitability action of natural of artificial life system. He considered first the issue of how the evolutionary new character appeared. In order to answer it, he proposed the evolutionary algorithm or genetic algorithm. The genetic algorithm was actually a kind of method that deduced from a genetic population to a new more suitable population by using the three operators of crossover, mutation and inversion. The deduction made the higher suitable genes gain more generations than the lower suitable genes. Generally speaking, Holland applied the method of computer imitation to describe the evolutionary appearing mechanism which developed the

self-reproducing cell automaton theory of von Neumann.

The representative theory of artificial life theory was C.Langton's theory of the definition on AL and some other foundation issues, Tomas Ray's digital life theory, S.A.Kauffman's genetic program theory, J.Conway's life game program theory and Wolfram's cellular automaton theory, etc.

With artificial life theory emerging, the research on artificial life philosophy rose. In the year of 1996, Margaret A.Boden, the academician of the Royal Academy of Science, edited to publish a symposium *Artificial life Philosophy*, which symbolized artificial life philosophy rising. From the contents of the symposium, the researches abroad on AL philosophy were very large in range and included following aspects: the definition of AL, the interpretation of AL on the essential of life, the philosophy thoughts on digital life, AL and AI, the origin and development of AL, the philosophy thoughts on virtual biology, the special tactics in AL, the relationship between AL and functionalism, the strength possibility of AL, etc. The fifth section of this book puts emphasis on discussing the theory and philosophy issue of AL.

the connection between algorithmism and pythagoreanism

Further speaking, pythagoreanism is concert with algorithmism in the field of computer philosophy. The most popular research guide of philosophy of computer science is algorithmism, and the most distinctive thesis is the "human=robot" thesis of Burks and the "recognizing =calculating" of Z.W.Pylyshyn. Pylyshyn, the chief protagonist of algorithmism is a famous psychologist and a computer scientist. His thoughts represent the orthodox view of cognitive science on understanding mind. He researches systematically, in his work *Calculating and Recognizing*, calculation and mind phenomenons.^[14] His nucleus statement is recognizing is a kind of calculating. In his opinion, coding the semantic contents of mental states resembles generally coding computer representations. We can summarize this thought in a thesis of "recognizing =calculating" that is the recognition process of knowers or informers actually has a strong equivalence relation with the calculating process of computer model. "Recognizing =calculating" is the nucleus thesis of Pylyshyn, the key of which is equivalence. In the view of Pylyshyn, equivalence is the relationship between computer model and the recognition process. If the equivalence points that the model realizes the same input-output functions of the life imitated, it is the weakest equivalent. It can be called input-output equivalence or action equivalence. It can be called Turing equivalence as well. Strong equivalence represents the conformance between computer model and recognition process. Simply speaking, strong equivalence points to the algorithm equivalence. Pylyshyn emphasizes that the cause of that strong equivalence is more suitable than weak equivalence is that it can represent the mental process better by using computer model.

What is the contact between pythagoreanism in philosophy of science and algorithmism advocated by Pylyshyn? Although the proposition of Pylyshyn's algorithmism is aimed to the recognition field, and considers that the recognition process of human has a strong equivalence relation with calculation of computer model, and the proposition of pythagoreanism, as a kind of view of nature, is aimed to the universe and considered that the universe moves and develops according to the mathematics rules; but pythagoreanism in philosophy of science is also the heuristic principle and methodology model of science recognition, and advice scientists, through conjecturing, to understand the universe secret according to the inherent mathematics mode of the movement and development of the universe. Plato considered God as an excellent geometrician,

and an excellent calculator as well. We are not against this version, but our “God” points to the self-organization universe itself. Pythagoreanism is broader, by comparison, and Pylyshyn’s algorithmism is more concrete; but, speaking from the general principle, the both are internal.

The new work *Considering the World with Calculation View*^[15] of professor Li quanming (Zhongshan University Press 2009), like a mirror, makes us more clearly recognize the inherent conformity between the more general algorithmism and pythagoreanism:

| The ontology commitment as the general foundation of science: reality is essentially calculative, and the universe is a great computer.

| The basic unit of constituting the world is calculation and information stream. The process happening in the nature is essentially the process of calculation or information processing.

| The value of epistemology of algorithmism: understanding the process of nature = establishing the relation between the calculating process in the brain and the calculating process of nature.

| Methodology significance of algorithmism: computer imitation experiment can be used to research the phenomenon and regularity appearing in the real system.

| The life process of natural life can be considered as a process that life macromolecules store, copy and alternate information for organization by molecular algorithm.

| The nucleus of the research guiding principle of recognized algorithmism, the basic work hypothesis of recognition science that recognition is the process of operating information can be interpreted by the regularity of representation and operation.

It can be seen, from that, that although pure algorithmism or pythagoreanism certainly can interpret fleecily the causality of the physical world, but it can not master the secret of life world better, even can not understand “self-organization phenomenon” of abiosis and “artificial life”.

Mayr, the famous evolutionary biologist, insists that the most excellent ingredient of Aristotle’s teleology is the thought of “program teleonomy”. Mayr defines “program teleonomy” as “a moving process operated by some kind of program and information password”, but Aristotle defined it as a special mode of “cause of form”/“cause of purpose”. In our views, the thought of Aristotle’s “program teleonomy” involved both elements “teleonomy” and “program or algorithm”, which indicated the potential possibility on integrating “teleology” and algorithmism or pythagoreanism.

Actually, all the routes of research guiding principle of modern artificial intelligence: the heuristic method search program of AI psychology, the cross correlation between neural net with circumstance of connectionism, or robot’s excellent study function by itself designed by behaviorist, can not get away the thought of “program teleonomy”.

In our opinions, algorithmism has rationality as well as limitation. On one hand, we should vindicate for the guiding principle of algorithmism. As the developments of complexity science, chaos theory, calculational chemistry, calculational biology and the other interdisciplines, recognized algorithmism’s method may continue to guide the research on recognition science in the 21th century, form new algorithm, such as artificial life, DNA computing, quantum computing, molecular automaton, etc, in new interdisciplines, as an example of the combination of computer science an biology, and then provide an opportunity for the development of intelligent calculation. On the other hand, we have to admit that recognized algorithmism is defective. As things stand,

recognition is not completely equal to calculation. When wanting to defend algorithmism, we must face these challenges and difficulties. We should surmount further the defects of algorithmism, without standing a pessimism position to the future of algorithmism simultaneously, which is actually possible outlet. Therefore, we will discuss the research guiding principle of algorithmism in computer science and elaborate the difficulties and possible outlet in the development of philosophy of computer science in the final section (the sixth section).

To sum up, what will open up in this book is actually a prospect of computer philosophy of science. Philosophy of computer science is a kind of theory method of computer and information. In this new philosophy paradigm, computer's computing provides a series of simple and abundant notions. The new evolving continuously notion brings new themes, methods and models for philosophy. It is transforming the modes of philosopher understanding the root philosophy problems and basic conceptions. A collected work *The Digital Phoenix* published in 1998 led extensive focus in academia, whose subtitle was "How Can Computer Change Philosophy". In the book, Bynum and Moor indicated clearly that the philosophy of computer science and information technology was a new force in philosophy. But in our views, artificial life is the representative of these new forces. We can say, to borrow from L.Floridi, the function of artificial life is just like Trojan horse, which brings more inclusive paradigm of computer and information into the philosophy castle.^[16] But we do not plan to make up a all-inclusive philosophy system. We just discuss several representative instances, such as Turing model, artificial neural net, cellular automaton, and hereditary algorithm, etc. These conceptions and themes are more and more focused by academia. The conceptions, methods and theory of information and computer have become a kind of frame of hermeneutics, by which the world can be interpreted. Generally speaking, just as what Bynum and Moor said, philosophy is not fixed and immutable; philosophy advances with time, which must renew itself continuously to hold prosperous. This power of self-renewing is exactly computer science and information technology.

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