The Transformation Brought by Soft Computing

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The Transformation Brought by Soft Computing

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Abstract: As a new theory of computer science and technology, soft computing has brought about a comprehensive change from technology to theory to thinking. Based on the perspective of historicism, this paper investigates and examines the specific changes brought by soft computing in the historical process of the development of science and philosophy, and deeply explores the transformative significance of soft computing.

Keywords: Soft Computing; Transformation; Historicism

1 Introduction

In 1992, Professor Zadeh L.A. clearly pointed out the differences between artificial neural network, fuzzy logic, genetic algorithm and traditional computing methods, and named the former as "soft computing". In 1994, Professor Zadeh published a series of papers, in which a) he divided computing into "hard computing" and "soft computing"(Zadeh 1994) and criticized not only symbolic artificial intelligence, but also the general methods of using precise and clear models to make the system operate (this type of general methods is characteristic of computers and engineering science, and he calls it "hard computing"); b) he clearly gave the definition of "soft computing", that is, “soft computing differs from conventional (hard) computing in that, unlike hard computing, it is tolerant of imprecision, uncertainty, partial truth, and approximation. In effect, the role model for soft computing is the human mind. The guiding principle of soft computing is: Exploit the tolerance for imprecision, uncertainty, partial truth, and approximation to achieve tractability, robustness and low solution cost”(Zadeh 1994); c)he compared soft computing to a "toolbox", saying that soft computing is "a collection of methodologies (.....) It mainly consists of fuzzy logic, neural networks and probabilistic reasoning, including genetic algorithms, chaos theory and parts of learning theory ”(Zadeh 1994). Since then, with the further deepening and expansion of algorithm research in the field of computer science, cultural computing, quantum computing and emotional computing have also been classified as soft computing.

The methodological advantages of soft computing enable it to be applied in many fields (system control, data mining, economy, medical treatment, art, etc.), and the research on soft computing by domestic and foreign scholars is becoming more and more in-depth. As Zadeh put it, the ontology, epistemology, ethics, social philosophy and educational philosophy of soft computing will become important topics for future development. As a new theory of computer science and technology,

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soft computing has promoted the development of modern artificial intelligence in depth at the technical level; has developed the algorithm theory by leaps and bounds at the theoretical level; has triggered a major change at the thinking level. All the changes are extensive and profound, and mainly reflected in the following aspects:

In Sect. 2, the transformation of soft computing in logic field: from the classical binary logic to the fuzzy logic of soft computing is analyzed. In Sect. 3, the transformation of mathematical concept brought by soft computing:from precision to approximation is described. In Sect. 4, the transformation of scientific research methods brought by soft computing: from static description to dynamic simulation is investigated.In Sect. 5, the transformation of the view of nature brought by soft computing:from the view of mechanical composition to the view of system generation is discussed. In Sect. 6, the transformation brought by soft computing in machine cognition is studied, which is a breakthrough from passive cognition to active cognition. In Sect. 7, the paper summarizes the significance of soft computing reform and looks forward to the future development of soft computing.

2 The transformation of logic view -- from classical binary logic to fuzzy logic

Binary logic means that a proposition has only two logical possibilities of "true" or "false". Since its birth, this classical logic has occupied an absolutely dominant position in science and philosophy. Until the beginning of the 20th century, the philosophy circle experienced the "linguistic turn", and the philosophy circle and the logic circle focused on the problem of fuzziness of language. Philosopher Russell pointed out, "every proposition that can be framed in practice has a certain degree of vagueness; that is to say, there is not one definite fact necessary and sufficient for its truth, but certain region of possible facts, any one of which would make it true. And this region is itself illdefined: we cannot assign to it a definite boundary"(Rudolf Seising 2015). Wittgenstein points out in his later work, "If we are not able to find such an exact logical language, then we have to accept the fact that there is vague linguistic usage in all languages. Then the images, models, and theories that we build with the words and propositions of our languages to communicate with them are and will also be vague"(Rudolf Seising 2015). To admit fuzziness and fuzzy language is not necessarily to fall into the mire of relativism, but to insist on a positive attitude, facing up to the existence of "fuzziness", and trying to explore an effective strategy that can bring fuzzy language into the reasoning process. By the middle of the 20th century, "accepting and facing up to fuzziness", imitating human's fuzzy reasoning ability, and seeking accurate logic that can deal with "fuzziness" have become the consensus of modern computer technology, artificial intelligence and other emerging science and technology fields. In 1965, Professor Zadeh published a paper "Fuzzy Set", in which he proposed the concept of "fuzzy set" for the first time. It was a key step in establishing fuzzy logic theory.

In fuzzy logic, the meaning of fuzzy words is essentially a problem of "degree". For example, the concept of "reddish" is fuzzy. Now we give a function about the

concept of "red", and we call it the "membership function". The range of the function is [0,1], and the meaning of "reddening" is determined by the "membership degree" of this membership function. So, the value of the concept of "reddish" can be any value between the [0, 1]. Although this value can take 0.1 or 0.8, seemingly random and uncertain, the range of values must be between [0, 1] and the meaning expressed by the interval value is accurate. "reddish" can only be within the scope of the "red" to a certain extent, but can't exceed the membership function. Thus, although the semantic value of the fuzzy concept is not an exact value, but an interval value, its meaning is exact.

With the introduction of "fuzzy sets", "membership function", fuzzy logic makes a standard for the meaning of fuzzy concept through mathematical methods, and gives the "precise meaning" to fuzzy concept, rather than the "precise value", which makes the fuzzy concept into the language “can be computed”, so as to realize the next fuzzy reasoning. Fuzzy logic is completely different from Aristotelian classical logic. It breaks out of the binary logic of "either/or" and introduces concepts such as "membership function" and "membership degree" to redefine a certain fuzzy word. In this way, the definition is given in the form of membership function, so that the fuzzy concept can obtain a relatively accurate digital and formal representation within a certain range of values, so as to realize the "precisiation processing" for fuzzy language. In an ideal language, "precision" is the primary feature and absolute standard, and there is a "one-to-one correspondence" between words and their referents. Only by the precise correspondence between words and their referents can the propositions constituted by words and words accurately depict the corresponding facts. In fuzzy logic, the meaning of fuzzy concept is essentially transformed into a "degree" problem, and the fuzzy meaning is determined by membership function and membership degree. The truth values of propositions made up of fuzzy words are not "unique", but there are "multiple" truth values. In fuzzy logic, the truth value of a proposition includes not only numerical truth value, but also linguistic truth value, not only internal truth value, but also external truth value.

Fuzzy logic is precise logic aiming at the "fuzziness", with the aid of mathematical language, logic language to redefine the fuzzy concept, fuzzy proposition, realizes the "precise processing" for "fuzziness" of the natural language. It makes the transition from " precise value" to "precise meaning ", becoming an effective strategy for fuzzy concept, fuzzy proposition to getting "accuracy" . of course, it is "relatively accurate", not “absolutely accurate”.

3 The transformation of mathematical view -- from precision to approximation

In ancient Greek times, Pythagoras put forward "everything is number", believing that the origins of the world are numbers and everything exists by imitating "number". Everything in the nature is determined by the relationship of number. All things harmoniously get together according to certain proportion. "Harmony is the unity of the heteropoly, is the coordination with harmonious factors "(Diers 1957). This

"harmonious" proportional relation contains a presupposition of "precise" mathematical relation. Everything is subject to precise mathematical relations which ensure that the celestial bodies in the universe are in numerical harmony.

Plato's idea theory of was deeply influenced by the Pythagorean school, and in his later years, he combined it with the theory that "everything is number"(Lin X. 1996), explained the internal logic of the theory of ideas and the theory of number.
“In Platonic philosophy, number is no longer shrouded in mystery. On the contrary, it is regarded as the true centre of the world of ideas, which has become the clue to finding all truth and comprehensibility ". It regards mathematics as the science that brings the soul out of the changing world into the real world. In Plato's view, the state of mathematics is eternal and can be correctly understood, and we can reach a definite, eternal and perfect world of ideas through mathematics. He regarded mathematics as a ladder from the sensible world to the knowable world, so Plato's pursuit of a perfect world of ideas was replaced here by the pursuit of precise mathematical relations or forms.

In the middle ages, Augustine combined such as Pythagoras, Plato's theory with Christian doctrine together, believing that God created all in accordance with the principle of mathematics. "When you took all these elements away, find nothing is retained. Where to find the number, size and order, where is found the most perfect form."(Harrson 1992) The steps from angel to earth, from spirit to matter, are descended in a "form of harmony". This "harmonious form" is a kind of "integral" order, which also contains the provisions of "precise" proportional relations.

During the Renaissance, Copernicus and Kepler carried on the ancient Greek tradition of "looking up at the stars" and believed that God had created the world according to a perfect mathematical formula (perfect contains precision). They are trying to find more deeper and more elegant mathematical formulas that can be integrated with the complex observational data, in order to find mathematical laws that can accurately describe the motion of celestial bodies.

To the 17th century, "the father of scientific experiments" Galileo pulled research object from the sky back to the ground, combined mathematics and mechanics, and combined mathematics with experiment, using mathematical language to describe the "ideal experiment" or "thought experiment" in the sports phenomenon, similar to the characterization of the precise mathematical and logical relationship between various elements in Plato's "idea world". Descartes, Galileo's contemporary philosopher and mathematician, regarded mathematics as the key to the study and understanding of nature, and created a highly effective mathematical tool -- analytic geometry, which believes that there is an accurate one-to-one correspondence between numbers and geometry. Descartes' philosophy emphasizes precision. In his philosophy of "universal doubt", mathematics occupies an extremely important position. The idea of mathematics, like the idea of God and the idea of extension, is true, which is clearly recognized by Descartes.

At the end of the 17th century, Newton was influenced by Descartes, was committed to use mathematical theory to study natural philosophy problem, and published in 1687 by landmark works *Mathematical Principles of Natural Philosophy,*

using mathematical language to clarify the law of universal gravitation and the three laws of motion, since then, Newton has painted a precise, mechanical, orderly and perfect world picture. Leibniz, who was contemporary with Newton, put forward "monadism", believing that God endowed a certain harmonious and consistent connection between monadism and its surrounding monadism, which is called "predetermined harmony", thus accurately defining the content and course of the later development of monadism.

In the 18th and 19th centuries, in a powerful belief in Newtonian classical mechanics, this determinism dominated the whole scientific world, and this absolute causal link was at the heart of the quest for mathematical accuracy. Laplace put forward a scientific hypothesis in 1814 -- Laplace demon, that this demon can know the position and momentum of every object from large celestial bodies to small particles in the universe, and can calculate the past, present and future of the universe by using Newton's laws of motion. It was widely believed by scientists and philosophers at this time that humans were capable of representing "completely and accurately" all observed facts in reality.

It can be seen that since the ancient Greek Pythagoras school, the scientific and philosophical circles have tried to conceive and depict the world of ideas or the real world with a "perfect" and "precise" mathematical relationship. Before modern science, the pursuit of "accuracy" mainly exist in the concept of "speculation", "abstract" default, But since Galileo, especially since the establishment of Newton's classical mechanics system, "accuracy" has been from "speculative" philosophical argument to "experimental" scientific reasoning, and "accuracy" has been important criteria in the development of science and philosophy.

Until the late 19th century and early 20th century, Frege, mathematicians and logicians, introduced mathematics into logic research, founded the mathematical logic, which still regarded "accuracy" of mathematics as the fundamental purpose. Mathematical logic, on the basis of precision, later became the prototype of the computer programming language, providing a key mathematical tools for the human first attempt to give intelligence to computer and machine. Because its algorithm process follows "symbolic deductive reasoning", this stage of artificial intelligence called symbolism of artificial intelligence era. From the 1940 s to 80 s, the development of symbolism of artificial intelligence entered the heyday, scientific research methods were increasingly dependent on computer systems, and the traditional study process of using artificial mathematics was gradually replaced by the numerical and algorithmic research of computer.

However, when symbolism artificial intelligence, which emphasized the "accuracy" of algorithm program, reached its heyday, its own limitations were fully exposed: the original accurate binary logic could not represent the fuzzy natural language; the original precise and static mathematical equations could not represent the complex system or process in reality; the exact solution of the original symbolic deduction was impossible to be obtained realistically in the real complex problems. All of these arise from the fundamental contradiction between the mathematical tools that pursue "accuracy" and the "fuzziness" of the problem to be solved. Due to the

objective reality of the problem to be solved, we can't change the essence "fuzzy nature", so the only way to solve this contradiction is to improve the mathematical tools, change the persistence of mathematics to "accuracy" for a long time, widen slightly the accurate boundary and replace "accuracy" with "approximation", which can more close to the representation for the real problem.

Fuzzy logic represents fuzzy phenomenon through membership function and membership degree, changes the original "classic sets" with precise borders, and passivation accurate boundary, expanding boundary from a precise value to an interval value between 0 and 1, in order to approximately represent fuzzy objects, maximum limit approximating the "ambiguity"of fuzzy object. In artificial neural network, genetic algorithm etc., the nonlinear equation is often be used mathematical tools. These nonlinear equations cannot directly obtain analytical solution, and only can obtain approximate solution by means of approximation. This calculation process is fundamentally iterative. So for nonlinear equation, it is not solving it, but iterating through it. The dynamic iterative process of nonlinear equation is also the dynamic process of the representation of reality problem. Eventually algorithm system obtains an approximation solution of equation, and this approximation solution is the satisfying solution of practical problems to be solved. It can be seen that the mathematical language used to write the book of the universe dose not always take the "accuracy" as the highest standard. Mathematics can be "imprecise". Changing from "accurate" to "approximate" may be a more appropriate representation of the universe, the world and all things.

4 The transformation of scientific research methods -- from static description to dynamic simulation

As the mathematics view changing from the pursuit of "accuracy" to "approximation", scientific research methods expand from hard computing into soft computing, and soft computing has been gradually adopted in various disciplines as a scientific research method. Soft computing has begun to infiltrate into logic, philosophy, artificial intelligence, complexity science, social science, economics, life science, art, and other study fields, providing an important support for the contemporary development of science and technology.

From 16th to 18th century, scientists generally believe that the world was designed by God according to mathematical laws, and the universe was written by the mathematics language. So most of the science giants at this time are faithful religious believers, and also in diligently explore mathematical laws in the universe. Mathematics is the foundational scientific research tools. Since the results of Ptolemy's Three Laws and Newton's Law of Universal Gravitation were expressed in the form of mathematical formulas, a mathematical static description of scientific laws has been formed. In reality, the mutual relations between material entities can also be abstracted and simplified into a mathematical formula with analytical solutions and formula solutions. The core path of this research idea and research method is to use a certain mathematical formula for describing the scientific law

statically, which is continued until the 1950 s. With the advent of the computer, the static description of mathematical formula shall be borne by the computer, so it occurs that the scientific laws lead to be computerized, algorithm, numerical. But ultimately it static describes the reality system by using a series of mathematical formula, and the core of the scientific research ideas and methods have not changed.

Until the 1980s, with the rapid development of computational science and technology, computers had been widely used in all kinds of scientific research. It occurred computational physics, computational chemistry, computational biology and a series of computational disciplines. Computer simulation and computer experiments had been widely used. However, for the real objects and real systems studied in this stage, only the static description of mathematical formulas could not meet the requirements. The complexity and non-linearity of the real system forced scientists to change their original scientific research ideas and methods, and to simulate the real system and process by the whole dynamic process of calculation. The real system was no longer abstracted as one or several algorithmic formulas to describe, but the dynamic development process of the real system was expressed by the cyclic iteration of nonlinear equations.

5 The transformation of the view of nature -- from the theory of mechanical composition to the theory of system generation

Mechanistic view of nature can be traced back to ancient Greece's atom theory. Leucippus and Democritus founded and perfected the theory of ancient atomism respectively, believing the world was made up of atoms and vanity, atoms in the vanity doing vortex motion created everything, and everything's generation was not without reason, but had its inevitable roots. In ancient atomism, everything is reduced as the only entity - atoms, everything's generation is reduced as the vortex motion of the atom. Although this speculative metaphysics concept is intuitive and simple, is not established on the basis of scientific theory, but we can already find the mechanical prototype, which in fact provides an important idea enlightenment for later development of western modern science theory.

In 1543, Copernicus put forward the heliocentric theory in his *Theory of Celestial Movement*, which opened the curtain on the development of modern natural science. Kepler proposed three major laws of planetary motion, which first defended Copernicus's heliocentric theory and influenced the discovery of universal gravitation. Galileo combined experiments with mathematics for the study of mechanics and created a new way of scientific research, which had a profound influence on scientific research at that time and later generations. On the basis of the research of these scientific giants, Newton established Newton's three laws and the law of universal gravitation, and established the classical mechanical system. Newton's *Mathematical Principles of Natural Philosophy* tries to explain all phenomena by applying mechanical principles, and all natural phenomena and movements are reduced to mechanical movements of attraction or repulsion between mutual forces, and all other phenomena and movements are deduced by mechanical principles. This means that

the state of motion of things at any time in the future can be inferred with certainty as long as the initial conditions of things are known. This mechanical view describes a "horological" picture of the world, in which everything ticks away in a given orbit according to the law of necessity. With the popularization of Newton's classical mechanics in the field of science and technology, the mechanistic view of nature has been highly respected, occupying the dominant position of scientific view of nature for more than 200 years.

It was not until the early 20th century that the emergence of relativity and quantum theory began to shake the dominant position of classical mechanics, and then the limitations of mechanical view of nature, such as one-sidedness and isolation, were exposed. Especially in the 40s, it emerged system theory, information theory, cybernetics; in the 60s, self-organization theory, synergetics, mutation theory and hypercycle theory were put forward; in the 70s complexity science, fractal theory, chaos theory were established, which completely broke the original mechanistic view of nature, painted a natural landscape of the system evolution development from elementary particles to human, from micro, macro to cosmic.

Hard computing is rooted in the mechanistic view of nature, thinking that everything in nature is in accordance with the operation of the law, and rules can be expressed with mathematical language. When all the laws are edited in symbolic calculus system into the computer, as long as the initial conditions of a certain phenomenon, the computer can calculate any state of the phenomenon at any a time in the future according to the program command. In the early stages of the vigorous development of artificial intelligence, this belief is extremely strong and firm. In fact, this conviction is for the most part rooted in human paranoid trust about mechanical view of nature. However, the first developing high tide of symbolism artificial intelligence, the reality practice is a blow to the human. Real problems are essentially nonlinear and complex, which makes symbolism artificial intelligence powerless, and requires artificial intelligence scientists to change ideas, to know the world in a new way, to jump out from the bondage of the mechanistic, to absorb nutrition from emerging scientific theory, such as the complexity science and nonlinear science, to find new possible paths for algorithm system.

Artificial neural network is developed from the connectionist theory of cognitive science, genetic algorithm is developed from the genetic evolution theory of life science, chaos algorithm is developed from chaos theory, and quantum computing is developed from quantum theory. Soft computing follows closely the latest frontier of scientific theory development, and creates a very different algorithm system from traditional hard computing. Since the scientific theory based on soft computing is fundamentally derived from the nature laws and life laws in reality, the disorder, randomness and non-linearity contained in the real laws also have their own logical space and logical structure in the algorithm system of soft computing. The generation evolution process of real system is embodied in the learning and application process of soft computing system. In a word, soft computing itself is the simulated representation of the real nature laws and life laws. The characteristics of soft computing are the criticism of the mechanistic view of nature, and reflect the view of

nature of the system generation theory. From the perspective of soft computing, the transformation of this view of nature is embodied in the following aspects:

First, from inorganic structures to organic systems. Although the natural view of mechanical composition acknowledges that things are moving and that things change, this movement change is limited to a mechanical displacement change, and there is only the interaction of forces between things, rather than any relationship of generation and evolution. In essence, this concept follows the theory of composition. The world is made up of atoms as the smallest entity, which form everything through interaction. The world is just like a machine, which consists of atoms and parts, which form the whole machine. Therefore, a hard computing system is also composed of step-by-step explicit program instructions, and all symbols in the system are organized by logical deduction rules, forming an algorithmic machine with rigorous logic and distinct steps. Soft computing is regarded as an organic system design, and the initial state of the system is "generating yuan", which realizes the generation and evolution process as a system initial growing point in the information communication with the outside world. During this process, this system itself achieves constantly improvement. Therefore, from the point of view of system structure, the transcendence of soft computing over hard computing is the transcendence of the organic system over inorganic structure.

Second, shift from external time to internal time. For the hard computing system formed under the natural view of mechanical composition theory, time is an external parameter. When the initial value and a certain time parameter are given, the analytical value at that time can be calculated. This algorithm can deal with some simple linear problems in some real professional field. The algorithm system is rigorous and closed, the passing of time will not affect the system itself, and it can be said that, the hard computing system is non-inductive for time. Time is just external parameter when solving the target problem, and is just used to indicate the realistic state at this time in solving the target problems.

However, it is different in soft computing system. Time is an internal factor, and the system will change its logical elements and logical structure with the passing of time, which will lead to the change of the whole system. So, soft computing system is sensitive to time, the internal elements at different time points may have very big change, but this is just what system generation process must go through. When soft computing dealing with the real problems, time is passing, and at the same time this system is changing itself constantly so as to improve itself. So for the nature view of system generation, time is a very important internal factor.

Third, to reconcile determinism and non-determinism. There is a natural correlation between the nature view of mechanical composition theory and the determinism. According to the theory of mechanical composition, everything in the world moves in the force of interaction and is governed by mechanical reasons and mechanical laws. All things and phenomena in the world are determined in this inevitable causal connection. Determinism denies the contingency, against which non-determinism puts forward that there is no necessity and law, and goes to the extreme of completely negating causality. The hard computing system is in

accordance with mechanical determinism, the symbolic reasoning process of the system is predetermined by the designer, and every step of the system operation is determined by the reasoning system.

However, soft computing does not conform to strict determinism, but it does not completely negate determinism, nor does it go towards the side of non-determinism. In oft computing system, there are inevitability logic elements determining the "quality" of system, at the same time, there exist also many chance logic elements. In the process of the exchange of information with the external environment, the inevitability logic elements guide the overall direction of system evolution, and the chance logic elements self-adjust and self-improve constantly in the direction of the overall system evolution, in which the system generates and evolves in a state of the orderly and disorderly coexistence. Therefore, soft computing system is neither deterministic nor non-deterministic. It is an application of harmonizing the two. The complementarity of the two can more accurately reflect the regularity of system generation.

Therefore, relative to the hard computing, the change brought by soft computing is profound. It embodies the times trend of nature view change. The nature view of mechanical structure theory has completely lost its glory in the past, and the rapid development of new science and new technology are changing the human cognitive view, changing the belief system of the scientific theory. The birth of the soft computing reflects the change of the times, the change of the nature view. Soft computing continues to create new achievements in the rolling waves of science and technology development.

6 The transformation of machine cognition -- from passive to autonomous

In symbolism artificial intelligence development period, the operating logic of the machine is "symbolic calculus reasoning". The programmer edits a set of calculating program according to certain logical rules and symbolic language. When the program is input to machine, according to which the machine processes the external information. Each step of the machine cognitive logic is edited beforehand by human, and this kind of cognitive style is passive, and has not any autonomy. This kind of passive cognition can only deal with some practical problems with closed characteristics in professional fields, but can do nothing for a large number of dynamic and complex nonlinear problems. In order to improve this situation, the computer scientists and engineers create connectionist artificial intelligence research paradigm and behaviorism artificial intelligence research paradigm, this two kinds of research paradigm are based on the artificial neural network algorithm and genetic algorithm in soft computing. Because the algorithm base takes a fundamental turn, it also causes the fundamental transformation of machine cognitive way and cognitive logic. The autonomy of machine cognition gradually strengthens, realizing the change from completely passive to autonomous cognitive. The enhancement of machine cognitive autonomy is also changing people's understanding of artificial intelligence.

First, from weak AI to strong AI. Searl initially put forward the distinction between "strong" and "weak" in artificial intelligence in order to oppose the view of "strong artificial intelligence". He emphasized that no matter how intelligent and cognitively autonomous machines are, they still cannot break through the gap to reach the level of human intelligence, which is that machines do not have intentionality and cannot understand semantics. This gap seems to be the ultimate ceiling for the development of artificial intelligence. At present, the development of artificial intelligence is in the stage of weak artificial intelligence. This gap is between human intelligence and machine intelligence, and machines can never surpass it, which becomes the congenital defect of machine intelligence.

However, when we look at artificial intelligence in a different way, we may find that this gap does not have much hindrance to the development of artificial intelligence. Machine does not have intentionality and can't understand the semantic content, but it just shows the machine cannot be understood in the form of a human understanding language semantic analysis. It still can use the form of the machine understanding language (syntax) to understand information. Even if the two types of understanding is not the same, realizing the man-machine communication has obtained satisfying solution and completed its cognitive tasks. There is no need to obtain the results only by human understanding the semantic way. Moreover, even though the communication process between two different people as human beings is based on semantic understanding, it may not guarantee that both parties fully understand each other's semantic content, so there will be so many misunderstandings and contradictions. Visible, because the cognitive subject age, identity, the knowledge structure, and context are different, for the same proposition of semantic content, the different subjects also have different understandings. If we regard the machine as a cognitive subject, it is only using its particular knowledge structure and its cognitive logic to "understanding" the semantic content (calculation), so the machine is only in their own way to "understand" semantic content. As long as it is able to complete the man-machine communication, man-machine interactive tasks, we can think "machine in his own way understand the semantic content".

Human cognition and machine cognition depend on the different material basis, which leads to machine intelligence never achieve completely human intelligence. But the development path of artificial intelligence itself is "imitating" human intelligence, and not "copying" human intelligence. After imitation, machine intelligence will form its own unique cognitive path and cognitive mode, the development direction of strong AI may itself be not whether the machine can have the intelligence the same as human intelligence, but whether the machine's "autonomous development" can form its own intelligence.

Today, artificial intelligence follows the path of "machine learning", and machine cognitive autonomy is unprecedented released. For example, input computer tens of thousands of dogs pictures, let the machine run automatically to extract the dog's characteristic and the concept, forming machine's own definition of dogs, of course, the definition of machine and the definition of human may have very big difference, but it does not prevent the machine to identify the picture of the dog

according to his own definition when collecting the chaos images the next time. Artificial intelligence is no longer limited to imitating human intelligence, no longer demanding machines to understand everything in the way that human beings understand, but to develop their own intelligent mode to realize the cognition of the world. Instead of worrying about whether machines can reach the same level as human intelligence, we should worry about whether machines will actually surpass Kurzweil's "singularity". We should focus on whether it will give human intelligence the overwhelming control, when machine become fully autonomous and completely independent of human intelligence.

Second, from intelligence imitation to intelligence enhancement. Artificial intelligence development initially started with the imitation of human logical thinking ability, to the later development of imitation of cranial nerve network, intelligent machine developing train is always down to imitate the human mind. So, it is inevitable to contrasting between the "machine intelligence and human intelligence", and to producing the division between "strong artificial intelligence" and "weak artificial intelligence". The development of "machine learning" reminds us that machines can develop their own cognitive mode independently, and machine imitating human intelligence is no longer the only development direction of artificial intelligence. This increasing autonomy of machine intelligence also raises one of biggest ethical concerns about machine intelligence.

At this point, the ultimate problem affecting the development of artificial intelligence may no longer be a technical problem, but an ethical problem of how to deal with the relationship between humans and intelligent machines. Obviously, the independent development of machine intelligence cannot be extended to all fields arbitrarily and unlimitedly. "Intelligence Enhancement" is a path for the current sustainable development of artificial intelligence, that is, "let human do human things, let machines do machine things". A core principle of this approach is to develop AI as a complement to human intelligence and replace it where it is weak. For example, in 2012, the Leibniz Institute for Astrophysics in Germany developed an artificial intelligence algorithm called KIGEN, which researchers used to calculate the distribution of dark matter in the universe after the Big Bang(Davenport 2018). It needs to be done very large computational work, but with the help of this artificial intelligence, they can model for the universe with unprecedented precision, and can study the formation process of the largest structure in the universe. The simple strengthening work of KIGEN is exactly its advantage. However, the time cost and manpower cost for human beings to complete such a large computing workload are immeasurable, or even impossible to complete. The intelligent enhancement strategy just makes up for the weakness of human beings and breaks through the limitations of human beings. At the same time, it will not steal human's work and realize the ideal cooperation state between human beings and machines, in which the value brought by each side will be amplified by the other.

Intelligence enhancement emphasizes the complementary relationship between human intelligence and machine intelligence, rather than the competitive substitution relationship. The ultimate development goal of intelligence enhancement is the

overall enhancement of intelligence application, rather than the competition between human intelligence and machine intelligence. Intelligent enhancement maintains the cooperative relationship of harmonious coexistence between human beings and intelligent machines. By on, the development of artificial intelligence from the original mimicking human logic, and then to imitating human neural network, and to machine learning phase, during the development process, the autonomy of machine intelligence is more and more strong, and cognitive ability is more and more strong, but at the same time, it caused the man-machine relationship problem also more and more getting people's attention and concern. Today, intelligence enhancement is feasible path of independent cognitive development of artificial intelligence, is both the feasible path of human development needs and security needs.

From passive cognitive to independent cognitive, it is the inevitable choice of machine intelligence self-development breakthrough. The artificial neural network algorithm and genetic algorithm, first of all, give the AI part independent cognitive ability, making the intelligent machine can complete self-adaption, self-organization, self-learning. This is the machine cognition from completely passive to independent cognitive for the first time, though at this stage of intelligent machines are not completely independent cognition. As machines changing the way of cognition, the relationship between human beings and intelligent machines is a subtle and profound changes accordingly, and the man-machine relationship become the future development of artificial intelligence ethical factors must be considered. Of course, to create a harmonious development of human and machine symbiosis situation is a focal point and the final destination for the sustainable development of artificial intelligence.

7 Conclusion

From a macroscopic point of view, the development of contemporary science and philosophy on the one hand poses a severe challenge to the study of traditional philosophy. On the other hand, it also provides a good opportunity for the exploration and innovation of traditional philosophy. In this process, philosophy and science are more closely combined, which is the future way of philosophy. Soft computing research from the perspective of philosophy is a comprehensive research involving computer science and technology, mathematics, logic, philosophy and many other fields. It not only belongs to the research field of philosophy of science, but also has a cross and integration relationship with other disciplines. Integrating use of logical methods, mathematical method, the method of linguistics, we investigate philosophy of soft computing, which is the combination of science and philosophy, the combination of scientism and humanism, and one of the latest research direction. Soft computing is developing and the technical change and the thinking change brought by soft computing will continue to expand and deepen, so studies on the philosophy of soft computing is still a long way to go.

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