Proceeding Paper
New Concept of Information Science †

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Abstract: With the development of information science and technology, people's cognition of information concept is gradually changing. The author puts forward a new concept of information science. It is believed that the universe is composed of two parallel worlds: the material world and the information world. In the material world, there are two main elements: matter and energy. In the information world, there are also two main elements: information and intelligence. To a certain extent, material science, energy science, information science, and intelligence science can be considered as four independent disciplines. This report explains the meaning, basic properties, patterns of change, mutual differences, and relationships of the four major elements of material, energy, information, and intelligence.

Keywords: material science; information science; artificial intelligence

1. Introduction

The traditional concept of information science is that the universe is composed of three elements: matter, energy, and information, and information science is a science that specializes in information elements. Therefore, in the whole scientific theory system, material science, energy science, and information science are three independent disciplines, and intelligent science is an advanced chapter included in information science. The subjective thinking and cognitive activities of the human brain belong to the research object of information science (including intelligence science).

The new concept of information science proposed by the author is that the universe consists of two parallel worlds: the material world and the information world. The two evolve synchronously, like a shadow accompanying each other. In the material world, there are two major elements: the occupancy of matter (reflecting the existence of matter) and the mobility (reflecting the existence of energy). In the information world, there are also two major elements of information: occupancy (reflecting the existence of information) and mobility (reflecting intelligent existence). Therefore, in the whole scientific theory system, material science, energy science, information science, and intelligence science are four independent disciplines.

This article briefly discusses the meanings, basic properties, changing patterns, mutual differences, and relationships of the four major elements of the material world and information world: material, energy, information, and intelligence.

2. The Formation of the Concept of the Four Major Elements of the Two Worlds
2.1. The Author's Personal Insights

The author has long been paying attention to the relationship and differences be-tween the objective and subjective worlds: on the one hand, the human brain is composed of matter, and the thinking process of the human brain is a process of energy transmission and transformation. On the other hand, the thinking process of the human brain is also a process of information transformation and intelligent activity. Matter and energy are real,

visible, and tangible. Information and intelligence are virtual, invisible, and intangible. The coexistence of reality and emptiness, like a shadow, evolves together.

Later on, I engages in research on computer science and artificial intelligence, expanding my perspective from the human brain to the entire universe, from the relationship between the objective world and the subjective world to the relationship between the material world and the information world. The integration between large and small perspectives deeply reveals the true essence of some objective laws. At the 4th International Information science Basic Seminar (FIS 2010, Beijing), the new concept of "the universe is composed of two worlds and four elements" was formally put forward in the paper "Thoughts on the construction of the theoretical system of Information science" [1].

Among them, some of the author's thoughts on intelligence science first appeared in "Intelligence Theory—Science on Information Processing Laws in the Human Brain and Other Systems", published in the third issue of the Journal of Artificial Intelligence in 1982. The main content of this article was presented at the First Academic Symposium on Artificial Intelligence in China (Beijing, 1980). The second symposium (Hefei, 1981) and the second national symposium on science (Hefei, 1980) presented oral reports on the relationship between instrumental change and the Scientific Revolution. Intelligence arises in the process of repeated communication and interaction between the cognitive subject and the object being concerned. Intelligence (including machine learning) can only be realized by high-order Turing machines. Various relationships between humans and machines must be positioned based on their respective strengths and weaknesses. It is necessary to accurately understand the measurement and amplification problems of generalized intelligence in three different meanings (intellectual ability, intelligent energy, intelligent power–intelligent energy per unit time). These most basic directional thoughts were later incorporated into the author's editor in chief's "Introduction to Artificial Intelligence" [2]. The new concept of information science proposed now is the sum of the author's lifelong insights, especially the crystallization of the "idle clouds, wild cranes" style of thinking after retirement.

2.2. The Historical Sediment of Humanity [1–5]

Therefore, all the logical properties of universal IMP operations can be used to describe the complete cluster of conditional probability universal logic operations.

In the modern history of science, human understanding of the objective world has roughly gone through the following processes:

(1) Modern science has developed on the basis of studying material science. Its basic idea is to believe that the objective world is material, and material is an objective reality that does not rely on consciousness but can be reflected by human consciousness.

(2) Dialectical materialism believes that matter is primary, consciousness is secondary, existence determines consciousness, and consciousness can react on matter.

(3) Material science believes that matter has two fundamental attributes: existence and agency. The earliest discovered and utilized by humans was the existence of matter (material properties), on which mechanical tools and material science emerged. It was not until modern times that the agency of matter (energy properties) was discovered and utilized, and on this basis, energy tools and energy science emerged. Although information attributes have long been discovered and utilized by humans, they have always been confined to the subjective spiritual and conscious world and do not belong to the objective world. The objectively existing information and information processes in nature have been neglected for a long time, while intelligence is considered a privilege that only humans can possess.

(4) Through the practice of developing information and intelligent tools such as computers in the past century, it has been discovered that the thinking process and intelligent activities of the human brain can be realized using information processors and artificial intelligence machines. Information and its material carriers, information processing processes, and intelligent activity processes coexist and are independent of each other, representing

two different aspects of the same thing. By utilizing these laws obtained from artificial systems to re-observe the network activities of animal spirits, life activities, and even various developmental and evolutionary processes in nature, it is found that they all meet this law. Any substance contains information, and the movement of any substance is accompanied by an information processing process. These discoveries have led humans to re-recognize and reposition information, information processing, and intelligence, liberating them from the subjective spiritual and conscious levels and becoming an information world independent of the material world in the objective world.

(5) The information world also has existence (information attributes) and agency (intelligent attributes), and humans have used these attributes to create many information and intelligent tools, resulting in the emergence of various disciplines studying information and intelligence.

(6) The premise of our parallel discussion of material science and information science is that the universe should be divided into two, the material world and the information world, which are interdependent and inseparable. In every world, there are two different fundamental attributes: existence and agency. Thus, the four fundamental elements of the objective world were formed: matter, energy, information, and intelligence, which are equally interdependent and inseparable.

3. Comparative Study on the Four Elements of Two Worlds

In the material world, how human beings understand and make use of material and energy to create human tools and power tools and gradually establish a huge system of material science and energy scientific theory has a very important reference of significance for us to study information tools and intelligence tools in the information world today and gradually establish a system of information science and intelligent scientific theory.

3.1. Human Experience in Utilizing Matter and Energy

(1) Material is the earliest element recognized and utilized by humans. In the material age that lasted for millions of years, humans mainly used various natural and artificial materials to manufacture various human tools. The basic scientific problem is to study the basic constituent elements and chemical changes of matter, and the core fundamental theory is chemistry. The discovery of Mendeleyev's periodic table of elements has made a significant contribution. The whole scientific theory system of materials has been formed based on chemistry.

(2) Since the 1760s, when we entered the energy era, we have mainly studied and used energy. Its basic scientific problem is the movement of objects and the law of energy conversion. The core basic theory is physics (calculus), which generally answers the mass, force, movement, and energy of materials and the law of their mutual conversion.

(3) The research of modern physics shows that matter and energy are essentially indivisible entities. There is enormous energy contained in the structure of matter, and changing the structure of matter will inevitably be accompanied by changes in energy (absorption or release), and there can also be mutual conversion between matter and energy. Based on this, it can be considered that the entire discipline of matter is a science that studies the existence (reflecting the existence of matter) and the activity (reflecting the existence of energy) in the material world. Physics and chemistry are its core fundamental theories, and its research content includes the structure of matter, changes in matter, forces and fields, motion of objects, and laws of energy conversion.

3.2. Exploration of Human Utilization of Information and Intelligence

(1) The instrumental revolution will inevitably give birth to new scientific theory. Now, information tools and intelligent tools have emerged and been widely used, which will inevitably lead to the birth of a number of new scientific theories and finally form a huge theoretical system of information science. The author believes that the basic scientific issues of the information age should be attributed to the structure and motion laws of information,

including primary information processing and intelligent information processing. In the past, it was thought that logic was the science of studying the law of chemistry thought, which was too one-sided. Modern application practice has shown that logic is a science that studies the structure of information and the laws of information processing. The author believes that the core fundamental theory of the information age is logic, because the occupancy of information in the possibility space is different from that of matter in the physical space: the occupancy of the latter is exclusive. Once a substance occupies a position, other substances cannot enter it, so the laws of motion in the material world follow calculus. The occupancy of the former is not exclusive, and two different pieces of information can share all or part of their positions in the possibility space, so the laws of motion in the information world follow logic. Of course, the existing logic cannot undertake this important task yet, and it needs to be further enriched and improved, at least including theories that can describe various information forms and structures, theories that regulate various information processing and transformation processes, reasoning theories that handle deterministic and various uncertain information, etc. This theoretical system is called universal logic.

(2) There are two stages of the information age. In the past few decades, the focus of development has been informatization, and the main task of information tools is for traditional information processing for deterministic problems in simple systems. The main direction of development in the coming decades is intelligence, and the main task of intelligent tools is to intelligently process uncertain problems in complex systems. It can be seen that there are two distinct periods in the information age, the information age and the intelligence age, with different development focuses. The main task of the information age is to utilize the existence of information to establish infrastructure and technologies for information collection, dissemination, storage, deterministic processing, and application. Mathematical formal logic plays the role of core foundational theories. The main task of the intelligence era is to use intelligent tools comprehensively in various fields of material production, social life, and scientific research, utilizing the initiative of information on the basis of informatization, to automatically handle various uncertain problems. For example, the core basic theory it needs is mathematical dialectical logic, such as the use of machines for outer space and deep sea exploration, knowledge discovery, intelligent decision-making, intelligent control, and intelligent services.

(3) The discipline orientation of information science is as follows. At present, there are many books on information science. Their common feature is that they all position information science on a specific subject, such as astronomy or biology. The author believes that if the information world is a world parallel to the material world, they have the same complexity and richness. Then, information science should not be conceived as a specific discipline but as a university discipline that can be compared with the "material Scientific theory sys-tem" (of course, this university discipline was also accumulated from small to large). Now, we have the successful experience of establishing the material scientific theory system, and we can take a more conscious, straighter, and faster way to establish the theoretical system of information science. The author believes that information science is a science that studies the existence and initiative of the information world. It is a large category of science, including basic science such as information theory, cybernetics and systems theory, applied science such as computer science and automatic control, and core basic theory such as general theory of mechanistic artificial intelligence [6,7], universal logic [8], and factor space theory [9]. The basic research content of information science should include information space, information structure, information change, the information field, and intelligence, the movement of the information body, and the transformation law of intelligence. At present, the research on the theoretical system of information science mainly has stayed in the qualitative research stage, and various departmental informatics are busy sorting out the information manifestations and characteristics in various specific fields and qualitatively describing them. However, quantitative theoretical research is an essential prerequisite for the establishment of the theoretical system of information science.

4. Conclusions

Although everything in the world was weak at the beginning, the positioning of the theoretical system of information science should be raised to the height that the universe is composed of two worlds and four major elements. And it is necessary to use a combination of qualitative and quantitative methods, mainly quantitative, to study. From the current situation, we are still far from this goal. The revolution has not yet been successful, and comrades still need to work hard!

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