

“1+4+3”: A Framework of New Science of Information

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Abstract: “Towards a new science of information”, put forward by Wolfgang Hofkirchner, is the theme of Fourth International Conference on the Foundations of Information Science in Beijing (FIS 2010), which is a new aim for global information scientists. This paper describes main features of traditional information science and advances a framework of new information science: “1+4+3”, in which “1” means theoretical informatics, “4” stands for communication theory, cybernetics, computer science, and robotics, and “3” indicates natural informatics, social informatics, and humanities informatics. The “1”, “4”, and “3” locate at three levels respectively: theoretical informatics, tool informatics, and domain informatics.

Keywords: Information, science of information, framework of information science

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We are glad to receive Professor Wolfgang Hofkirchner’s email on 12 January 2010. “It would be my severe desire to dedicate the Beijing conference to the founding of a new science of information, to make it the first conference on that topic”, said he. Then with Professor Pedro C. Marijuán’s support, “Towards a New Science of Information” has become the theme of Fourth International Conference on the Foundations of Information Science in Beijing (FIS 2010).

We believe that the first FIS conference in Madrid, in 1994, is the beginning of the new science of information. In 2004, an early version of theoretical informatics advanced is another important milestone in the same approach. The task of new science of information is to explore a common ground around information concept, a new scientific perspective, a connections of the different information-related disciplines, and a new framework for transdisciplinary research.

In this paper, we try to describe some features of the new science of information and

advances its knowledge framework based on the results of theoretical informatics. We call the framework “1+4+3” and will give an explanation in this paper.

1. Main Features of Traditional Science of Information

In a certain sense, we believe that the Madrid Conference (1994) marks a special point in the time line: before the point, the information science is traditional; but after the point, a new science of information is developing gradually.

Generally speaking, science of information should include three branches: theoretical informatics, tool informatics, and domain informatics. The critical difference between traditional information science and the new one is whether it has its foundations, i.e., theoretical informatics (namely general informatics), or not.

Since 1940’s, Shannon’s mathematical theory of communication, Wiener’s

Cybernetics, Turing and von Noeman's computer model, and artificial intelligence and robotics have established, which we call "*tool informatics*" because they are employed as four tools for dealing with information processing as an abacus does in China. With the updating upgrade of micro computers, four information tools have entered variety of information fields, e.g., biological, medical, etc., then another group of information subjects emerged, which we call "*domain informatics*", like bioinformatics, medical informatics, etc.

The main features of traditional science of information are:

(1) It obeys the scientific paradigm of natural science: its objects are material, its methods are physical and mathematical, its expression is quantitative and formulatic, its procedure is determinative.

(2) It is based on physical world-view: there are nothing except matter and its motion in the world; so called human spirit phenomena can be reduced to material movements and explained by physical laws sufficiently.

(3) In traditional science of information, Shannon's theory is the only part which is considered scientific; however it belongs to mathematics, or mathematical application; therefore, there is only information technology without any information science.

The authors of this paper hold that Shannon's theory is only a communication theory which is not involve in "pure information" or the meaning of information carrier. That is the reason why traditional information science should be exceeded by a new science of information.

2. Special Facets of Theoretical Informatics

Theoretical informatics is primarily a synthesis and distillation of practical (or applied) informatics. Its concepts, principles, and methodology, which are not the contents of this paper, should be used in all applied informatics. It is a bridge between information science and information philosophy. Hence it has two main contents: scientific fundamentals and philosophical basis of the knowledge related to information phenomena.[1]

The special facets of theoretical informatics are:

(1) Be based on information world-view. Before theoretical informatics, the material world-view dominates the realm of science. But now everything has a feature of matter-information duality, information phenomena only be explained by information laws, and scope of effects of physical laws is only limited in the phenomena of information carrier.

(2) Employ informatics methodology—information emergentism. The structure of a physical system is in Newton's mechanics space, so physical power drives any concrete object's movement. However, the structure of an information system is in the intelligence space, as a result, the mechanism of information emergentism is within logic and program, which can not be quantized and expressed in mathematical formula.

(3) Obey information science paradigm. New science of information maintains that there two types of science: material science and information science; they have different objects, methodologies, principles, and modes; they stand opposed to one another but complement each other, like hardware and software in a computer or a robot. New information science paradigm will be accepted gradually by scholars and public.

3. "1+4+3": A Framework of New Science of Information

3.1. Why a framework of new information science is needed?

A framework in a knowledge system is a classification which puts different parts of learning in an appropriate location or level and has them to be in an organic system. In general, classification is an extension definition for a concept, and plays a supporting role of related intension definition of the concept.

For example, we can use a method of "one divides into two" (i.e., A and not A) continuously for treating with the all disciplines in the whole information science: first, theoretical informatics and practical informatics; second,

tool informatics and their applications; third, natural informatics and non-natural informatics; fourth, social informatics and humanities informatics; etc.

3.2. The historic procedure of the framework of new information science

There are two kinds of framework of science of information: plane structure and stereoscopic structure. An early plane framework was developed by a Chinese scholar, Xue-Shan Yan in 1997. He said that the group of disciplines of information science consists of six branches: communication informatics, computer informatics, optical informatics, biological informatics, animal informatics, and human informatics. [2]

In 2010, a Russian scholar, K.K. Kolin, put forward another plane framework. He said that the structure of information science includes six parts: theoretical informatics, technology informatics, social informatics, bio-informatics, inorganic informatics, and energy informatics. [3]

In 2004, Zong-Rong Li advanced a stereoscopic structure: theoretical informatics and practical informatics in his dissertation. In

order to express the structure simply and conveniently, following Xue-Shan Yan, we may call it "1+1".

In 2007, Xue-Shan Yan proposed another stereoscopic structure, "1+3", which means that information science is composed of one theoretical informatics and three practical informatics, i.e., tool (or engineering) informatics, natural informatics, and social informatics [4]. Here "3" is still a plane classification because the methodologies of three informatics locate at different levels: the method of tool informatics is much more general than the method of domain informatics.

In this paper, we develop the third stereoscopic structure, "1+4+3", in which "1" means theoretical informatics, "4" stands for communication theory, cybernetics, computer science, and robotics, and "3" indicates natural informatics, social informatics, and humanities informatics. The "1", "4", and "3" locate at three levels respectively: theoretical informatics, tool informatics, and domain informatics.

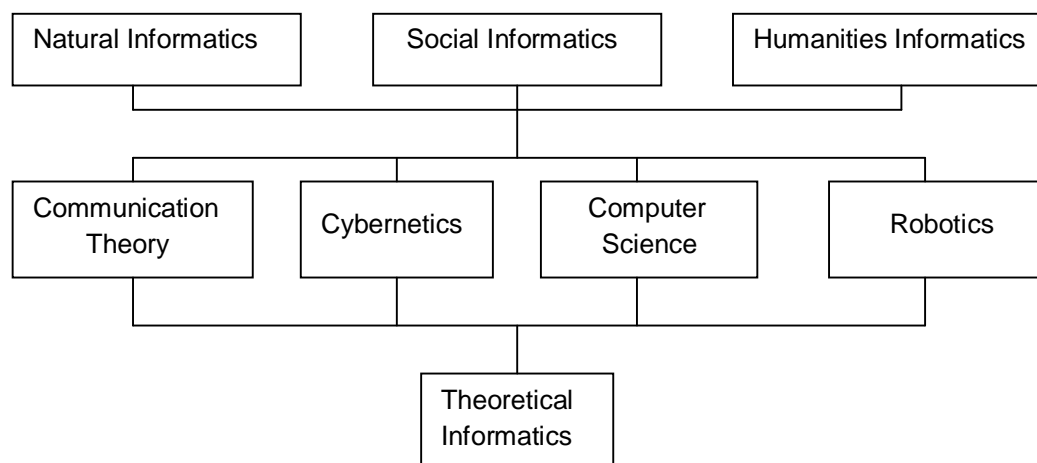


Figure 1: "1+4+3" Framework of information science

3.3. The relation between Robotics and computer science

For some scholars, robotics is a part of computer science, however, other professionals hold that computer program is determined by an algorithm while a robot protine may be undetermined and the former is a special condition of the latter.

In our opinion, both robot and computer are information processor which are employed in different situations respectively, so they are belong to the type of tool informatics.

3.4. Why to separate humanities informatics from social informatics

There are three laws in the universe. The first is natural laws which are beyond people's wills and ideas; The second are social laws which are made by people in different institutions in society based on the rule that the minority is subordinate to the majority; The third are personal laws which are made by people among friends, relatives, spouses, lovers, or members in faminy based on love and belief.

If we use social laws to treat with emotion affairs, they do not work well, e.g., when a third party gets into a faminy, some times he/she is bad and disruptive, but some times he/she is helpful and good. Another example is when a husband is becoming to love other lady, his wife may choose a choice among many strategies, e.g., to divorce from him, ignore what hanppens, try to atract his heart again, etc. We can not say which stratege is right or good, others are wrong or bad.

4. Three Schemes for Building Unified Theory of Information in China

4.1. Scheme 1: based on *the conversions from information to intelligence*

Professor Yi-Xin Zhong published his monograph, *Principles of Information Scxience*, in 1986. Then the book was revised in 1996, 2002, and 2005. He believes that the core of information science is the conversions from information to intelligence. [5]

He says that the conversion from information to knowledge, which is termed as

Cognition, is the one of the central process in the entire processes of information. The quality of the conversion is mainly determined by the quality as well as the quantity of the comprehensive information provided and also by the appropriateness of the methods used in conversion. This explains the reason of why the task of knowledge extract from information can only be performed by human beings, or intelligent systems.

4.2. Scheme 2: based on theoretical informatics and framework "1+4+3"

Professor Zong-Rong Li published his dissertation, *On Theoretical Informatics: its Concepts, Principles, and Methodology*, in 2004. Then he prints a textbook, *An Introduction to Theoretical Informatics*, in 2006. As a report on his post doctoral research, *On Worldview of Information Science*, produced in 2008.[6] Then a new Chinese version and an English version of his textbook are issued in 2010 for the convening of Fourth International Conference on the Foundations of Information Science (FIS 2010).

In this paper, he and his co-researchers put forward a new scheme for the whole theory of information science: "1+4+3". Based on this new framework, they will build a new building of information science.

4.3. Scheme 3: based on the theory of universal logic

Professor Hua-Can He has been working in the fields of computer science and artificial intelligence more than half a century. He synthesized his achievements in theoretical and practical researches then advanced a new knowledge system, the theory of universal logic.[7]

In his opinion, logic is the basic rule in all kinds of information structure and evolution, including human thinking and machine's information processing and artificial intelligence. By means of universal logic, he says that a new science of information can be expressed, including the theory of variety of information forms and structures, the theory of information processing and transmissions,

and the theory of the reasoning of determined or un-determined information.

5. Conclusions

The “1+4+3” framework of information science is only an overall structure for the whole knowledge system. “1”, “4”, and “3” locate at three different levels: theoretical informatics, tool informatics, and domain informatics. The development of each level and part is different from one another.

In its application level, there is not total natural informatics up to now, social informatics is developing in Russia, Japan, USA, and China, and a humanities informatics was proposed by Russian scholars and some Chinese scholars are interested in it but a few

people know what it is. The tool informatics are developed. At the basis of practical informatics, theoretical informatics is established newly, including its philosophical contents, mainly information worldview, i.e., the relation model of matter and information in the universe; and its scientific contents, i.e., its concepts, principles, and methodology.

We believe that a correct preliminary draft will guide the detailed design for the development of a new science of information, as the cases in complex software engineering and hardware engineering.

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