

Letters to the Editor

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Knowledge Ontology: A Tool for the Unification of Knowledge

One important mission of knowledge organization is to construct a united KOS (knowledge organization system) that covers general and special domains and cover experts and ordinary users. To this end, I propose the “knowledge ontology” project based on a human-needs driven knowledge classification model (Guohua Xiao 2013). Five related ontologies accessible at the URL (<https://github.com/knowledgeontology/KO>) are being constructed (in OWL format by Protégé (Mark A. Musen 2015)): “pure methods,” “pure technology,” “pure theory,” “social life,” “personal life.”

The “knowledge ontology” is based on the core hypothesis (the philosophy of “knowledge ontology,” Figure 1A): language is the clue linking personal life to the universe. The idea is similar to the “tree of knowledge (Henriques, G.R.2013),” but the difference is that the “knowledge ontology” makes an obvious distinction between the real world and the knowledge on the real world. There are two meanings of language: a broad one and a narrow one. Apparently, the narrow one is symbolic language that we human beings use. Based on languages, we create a virtual world: knowledge. However, the broader understanding considers the law that nature and society abide by. For example, the life world run by the language composed with mainly four letters “ATGC.” The DNA language creates “the DNA knowledge,” which creates a higher language

(neural language). The process likes a chain linking the universe to personal life. So, the higher-level language has the ability to reflect the lower language. We also use the life world as an example: the animals can perceive the nature by vision and audition; the animals use a neural language that is higher than the DNA language. Specially, we, human beings, use the highest-level language: the symbolic language. So, we get an ability that the animals do not have: to explain the real world. Specially, we create linguistics to explain language with language itself.

Let us try to answer three basic questions (Smiraglia, Richard P. 2014) on knowledge organization in another way:

Q: How do I know?

A: By language (language is the foundation of knowing).

Q: What is?

A: By philosophy (including mathematics and aesthetics, tools to distinguish).

Q: How is it ordered?

A: By science of knowledge (to find structure).

I integrate language, philosophy and science of knowledge as the first ontology in the “knowledge ontology.” The three parts are dependent; that is why computer scientists use knowledge graph technology to analyse NLP (natural language processing) by machine learning (methods, can be considered as philosophy here); meanwhile, NLP also supports the knowledge graph construction.

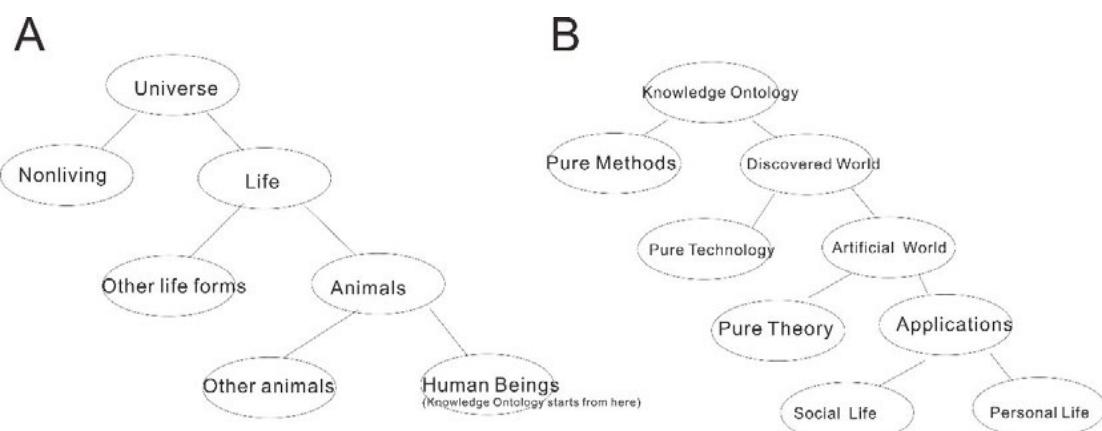


Figure 1. A) The core philosophy of knowledge ontology
B) The structure of knowledge ontology.

Based on the core hypothesis described above, I designed the following rules to organize knowledge (Figure 1B):

1. Isomorphism:

Figure 1(A) describes the hierarchical structure of the world. The “pure methods” ontology is a special ontology that can be seen as a link between the real world and knowledge (it is a special spot, not involving any entities). So, we can see four ontologies (except “pure methods”) in “knowledge ontology” as four mappings of the real world. I will explain why the four ontologies are homogeneous with the real world using an example. Such as knowledge on languages and knowledge can be located in (the example is an extension of “The brain is a knowledge graph” (Guohua Xiao 2019):

- In the real word: the potential ability for human beings to create language and knowledge
- Pure technology: knowledge graphs in artificial intelligence
- Pure theory: brain semantic networks
- Social life: applied psychology dealing with language barriers
- Personal life: knowledge on speech and communication

2 Dichotomy:

Dichotomy is easy to understand. In the human-needs driven model, I classify the knowledge into scientific method and sciences. And in “knowledge ontology,” the dichotomy rule is used more widely, such as “pure theory” vs “application,” “social life” vs “personal life.” Moreover, the dichotomy rule is easy to be used to analyse interdisciplinary subjects.

3 Trichotomy:

Material, energy and information are three aspects of the world, which is the source of trichotomy. So, I divide sciences into three parts: natural science, social science and cognitive science. Similarly, “personal life” can be divided too: natural needs, social needs and cognitive needs. There is a new application of the trichotomy rule in “knowledge ontology:” “pure theory” or “application” can be divided into:

- Sciences (hard but real knowledge, based on mathematics):
On how to understand the world (in “pure theory”) and how to change the world? (in “application”)
- Arts (soft but real knowledge, based on aesthetics):
On how to constrain the understanding and changing above?

–Religions (void knowledge, not real, but also useful):

- We human beings must get a complete explanation of the whole world (due to the limitation of cognitive ability, we need religions)!

Next, I will introduce the structure of the “knowledge ontology” briefly (Figure 1B). “Pure methods” refers to theoretical methods mainly composed of languages, philosophy and science of knowledge, which are discussed above. “Pure technology” is near to technology science, which supply tools but do not satisfy human needs directly. The three basics of “pure technology” are material, energy and information that integrate a comprehensive technology: robotics. “Pure theory” and “application” (including “social life” and “personal life”) have the same structure, which are composed of sciences, arts and religions whose relationships are discussed above. But “pure theory,” “social life” and “personal life” have different focuses. Specially, “personal life” refers to the Maslow’s hierarchy of needs (Maslow, A.H. 1943), and these ontologies are homogeneous. That is why the model is human-needs driven. Detailed ontologies can be downloaded from the URL of “knowledge ontology.”

Finally, in order to compare “knowledge ontology” with another two important KOSs, Peirce’s classification of sciences ([https://en.wikipedia.org/wiki/Classification_of_the_sciences_\(Peirce\)](https://en.wikipedia.org/wiki/Classification_of_the_sciences_(Peirce))) and Information Coding Classification (Ingetraut Dahlberg 2012), I annotated these two KOSs to the “knowledge ontology” (only high level terms are annotated at present, and annotation files can be downloaded from the URL of the “knowledge ontology”). Here, I just give an example of the annotations: in Peirce’s classification of sciences, there is an interesting classification, “science of review.” I think it has a similar meaning with “religions,” so I annotate it to “religions” in the “knowledge ontology.”

In summary, I described a theoretical framework of a tool for the unification of knowledge in the letter. The ontologies and annotations will be updated in the future, which will make the “knowledge ontology” and its annotations dynamic. I hope it is useful for both experts on knowledge organization (just another KOS) and ordinary users (a tool helping to choose a career). By the way, I thank Prof. Changle Zhou at Xiamen University for some inspirations from his open lectures.

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Annual Progress in Knowledge Organization (KO)? Annual Progress in Thesaurus Research?

Earlier we had the publication *Annual Review of Information Science and Technology*, ARIST, published from 1966 to 2011. It belongs to a family of *Annual Reviews* that are very popular (and highly cited) in almost any discipline (and often such *Annual Reviews* exists in subfields too). I have always been interested in this kind of research synthesis (along with many other kinds). But it has struck me that they almost never live up to their names—or at least what I expect from publications with such titles. They almost never consider progress in the same field year by year (this is also true for my own contributions in this genre, Hjørland 2007; Hjørland and Capurro 2003; Hjørland and Kyllesbech Nielsen 2001). (This does not make them an unnecessary scholarly genre, however; they are still very fruitful by presenting and reviewing publications in the field on a more or less regular basis).

Have a look at Table 1:

2019 (1)			2003 (11)		1987 (7)			1972 (24)
2018 (10)			2002 (9)		1986 (17)			1971 (13)
2017 (9)			2001 (7)		1985 (10)			1970 (20)

2016 (13)		2000 (6)			1984 (11)			1969 (14)
2015 (12)		1999 (12)			1983 (14)			1968 (12)
2014 (10)		1998 (19)			1982 (22)			1967 (5)
2013 (11)		1997 (14)			1981 (20)			1966 (4)
2012 (9)		1996 (7)			1980 (13)			1965 (5)
2011 (9)		1995 (25)			1979 (15)			1964 (3)
2010 (22)		1994 (32)			1978 (18)			1962 (3)
2009 (10)		1993 (19)			1977 (13)			1961 (4)
2008 (12)		1992 (27)			1976 (18)			1960 (1)
2007 (14)		1991 (26)			1975 (20)			1958 (1)
2006 (17)		1990 (38)			1974 (16)			1957 (1)
2005 (15)		1989 (21)			1973 (13)			1947 (1)
2004 (15)		1988 (24)						

Table 1. Publications indexed in *Web of Science*.

This table shows the number of publications indexed by *Web of Science* in the subcategory "of information science and library science" containing the word "thesaurus" or "thesauri" in the title (total of 824 documents). Now my question is: what progress has been made concerning thesauri year by year by all these publications? Can we say that specific kinds of progress have been made each year, or each year with more than five publications, or could we characterize progress in thesaurus research for each five-year interval (including, of course theoretical and metatheoretical contributions), or are all such ideas of identification specific progress in thesaurus research problematic and unrealistic? I guess they are. One reason could be that we have a culture when we do not expect of publications to contribute new knowledge to the field, but just to write papers about something in the field. If this is the case, it is, of course, a sign of a crisis and a problematic scientific culture. In my opinion, this may also be related to another problem: that research too little takes its point of departure in the research literature, and considers its knowledge