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To Develop the Human-Computer Complex Pansystem in Medical Knowledge Engineering: "Computman"

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Abstract

The paper analysed the reasons why the medical artificial intelligence researches, including computer-based medical decision-making researches, were not so successful in the history of Medical Informatics. And it was found that the neglect of so called "unexpressive information or knowledge Base(UKB)" in human brain may be an important reason for that. Based on the research of Integratable Relationized Electronic Medical Book(IREMB) and its language exploration of Human-Computer Shareable Language(HCSL), a kind of pansystem named "Computman", which is essentially different from the classical artificial intelligence systems such as data base, knowledge base, all other kinds of traditional medium and human brain itself, was presented in the paper. Finally, the prototype of HCSL, which is under being updated, was briefly described.

Keywords: medicine, computer, Internet, Medical Informatics, Pansystems Theory, knowledge process, knowledge integration, artificial intelligence

1. Pansystems Theory: an philosophy-mathematics-technology integration exploration

As many articles and books on Pansystems Theory have stated, Pansystems Theory is a transfield multilayer network-like and encyclopedia-connecting research with the emphasis on Pansystem(generalized systems, generalized relations or/and their various compositions) and unification (melting the philosophy, mathematics, technology, aesthetics into a unified entity).

Compared with all other philosophies, Pansystems Theory has its so called six-characters,i.e. pansystemization, multiple-discipline combinization, relative general application, relative general concreteness(relative full observation-controllable modelization) and integration (philosophy-mathematics-technology integration) exploration[1,2,3]. It seems that the last one, the integration exploration, is the main and most challenging goal among those six roles or characters.

It is absolutely true that the multiple-discipline integration or networkization is a long dream of human being and its many great scientists, including M. Planck and E. Schrödinger. It is just the same natural as that people ever expect the highway-network, railway-network, airline-network ,telephone-network, Internet(net-network) etc.

As we know, that the differentiation(such as classification, analysis, definition, division, narrowness

etc.) of things is the mother of most sciences. As a result, the science branches are nowadays getting more and more, and the scopes they cover are getting narrower and narrower. The birth of a new science means usually the lose of individualities in that field. For example, one of the famous Newton's laws, F=MA, neglects any other actual attributes of those objects, such as their shapes, sizes and materials, etc.

Integration,however, implies that we should do in opposite way. We should unavoidably face to the complicatedness and infiniteness of individualities. Generally speaking, for various disciplines, the more they close to philosophy, the higher abstraction of the concepts, the more suitable for discussion on generalization or integration. And contrarily, the more they close to the pragmatical sciences, the more individualization of the concepts, the more difficult for discussion on generalization or integration. Thus we should be fully aware that the challenges in the integration efforts, especially for those fields close to the pragmatical techniques, are nonimaginable.

2. Some more science-philosophy thoughts about integration-type and differentiation-type researches

As we know, sciences are not equal to nature. Sciences are only partial nature or even only narrow, partial simulation of nature. This fact can be considered as one reason why, in our scietific times, when sciences have brought various bloomings and modernizations to people, they have simultaneously brought many serious problems, such as ecological imbalance and source exhaustion, to human being.

Philosophically speaking, it is because of another "ecological imbalance" in science development. People always do breakdown-type work(or "grinder-type work" as we call it), perhaps, for quicker successes, or "going a easy way to Nobel prize"(as some author stated). Whereas to another more important work, i.e. the integration-type work(or "spider-type work"), people have never paid the considerable attention.

People have dropped into the endless cycle, which orderly includes: (1)being interested by instinct in understanding and reformation of nature; (2) differentiation, classification or breakdown of nature , creating a new science; (3) leading to "only narrow, partial simulation or understanding of nature"; (4)returning back to (1).

Because this cycle, people will make more and more new sciences and their branches, while never get more integral understanding of nature. We can see this clearly when taking Linquistics as an example. Linquistics, in which people nowadays are more and more interested, has been divided into Syntax, Semantics, Phonetics, Morphology, Pragmatics, Computational Linquistics, Applied Linquistics, Psychological Linquistics, Fuzzy Linquistics, Fuzzy Semantics, etc. The things are perhaps far from over. So it should be a self-evident opinion that the integration or combination of two, three, four,….. or more, or even all sciences, that is the goal of Pansystems Theory and other integration-type researches, will bring us fuller understanding and reformation of nature.

3. The integration-type research in Medicine.

IREMB(Integratable Relationized Electronic Medical Book) is the an integration-type research in medical knowledge, which was presented under the influence of Pansystems Theory. The most

important and intrinsic characters of medical knowledges are their pragmaticality and individualizations (or individuality-dependence). In medicine, effectiveness is almost every thing. The processes, operations and integrations of medical knowledges inherit those characters, naturally.

In medicine, the term integration has got many definitions or meanings up to now. The generalized integration in IREMB means the association or mentally connecting, electronically linking or accessing, one-to-more or less-to-more operations(seriesllly or parallelly), logically transmitting and so on, of medical knowledge. In other words, it means any efforts to make those traditionally isolatedly used knowledge(or relation) pieces be more unitedly used. The term integration in IREMB extra means any efforts to make the lives, diseases, diagnoses, treatments be understood and treated more based on multiple-disciplines rather than on isolated-discipline, through the electronically storage, processes and operations of medical knowledge.

4. A historical lesson in Medical Informatics

In the history of Medical Informatics, numerous expert systems, decision-making systems, knowledge-base systems which have been developed for decades are not as effective as they were expected.

The book of <Handbook of Medical Informatics" said[5], "Having gained more basic insight into computer-based decision support in health care, developers abandoned the Greek Oracle model by the early 1990s. Over the years, several DSSs evolved along the way of this better insight into usable medical DSSs. For example, the style of diagnostic consultation in the original 1974 INTERNIST program viewed the clinician as unable to solve a diagnostic problem. The model assumed that the clinician would transfer all patient history information, physical examination findings and laboratory data to the INTERNIST-I diagnostic consultant program. After patient data entry, the clinician's subsequent role was that of a passive observer, answering "yes" or "no" to questions generated by INTERNIST-I. Ultimately, the omniscient Greek Oracle(i.e. the consultant program) was to provide the correct diagnoses and their probabilities of occurrence and to explain its reasoning." It said further: "People and particularly experienced clinicians are capable of reasoning with incomplete and imprecise information and they often make clinical judgements even at a time when they have unfulfilled information needs."

But the situation seems not the case. People and "experienced clinicians" by no means can reason "with incomplete and imprecise information". For explanation of it, we should not forgot that there is always unexpressive information or knowledge base (UKB,a kind of hidden knowledge base) in human brain. People, actually, use the "incomplete and imprecise information" plus UKB in human brain when doing reasoning, judgement, decision making or communication.

The aritificial decision support is always accompanied by the generalized knowledge processes, no matter it is made by computer or by human being. In a sense, knowledge processes could be considered as the questions of Linquistics. Whereas a language could be , at bottom, viewed as a protocol between people. Correct understanding each other is every thing for the protocol. Usually this protocol contains two parts: the expressive part(visible, readable, hearable or expressive knowledge base, EKB) and unexpressive part(UKB). And we know that the languages are strongly

context-dependent. If people have been living or working in the same environment for a long time, the common UKB in their brains ,which is the source of hidden context of language, would get larger.

Thus, it is explainable that when we talk about medical expert systems, decision-making systems and knowledge systems, we simply mean those intelligent actions of computers, systems or data bases, where there is no UKB at all. Because of this UKB in human brain, there is a considerable gap between the intelligent actions of computer and human being. It is just the gap due to UKB that makes those medical artificial intelligence researches be not so satisfied so far.

5. “Computman”: a new subject on the medical artificial intelligence

The advantages of the human brain are the abilities of thinking in terms of image, concept-creation, “large-span” judgement through UKB in the brain and something others. These are just the weak points of computer. Complementarily, the strong points of computer are the mass memory and its fast operation
speed which are helpful to the human brain. It explains why people continuously try to strengthen the brain of human being through the combination of human brain and computer.

Traditionally we have the classical knowledge base or data base which is strictly structured(some times with limited assistant text) and usually readable and “understandable” only for computer. We also have the classical nonstructured free text knowledge carriers such as books and journals, which are readable and understandable only for human, and consequently communicatable with UKB in human brain. Therefore, the key point is that we should create a new type of knowledge base which is readable and understandable for both computer and human being, to serve as a “bridge” to link the EKB in computer and the UKB in human brain. In a sense, such a medical knowledge base is the combination of
the classical medical knowledge base and the classical medical book. We named such a new type of knowledge base as Human-Computer Shareable Language(HCSL). In HCSL, we add the extra necessary attaching natural texts(ANT) to the traditionally structured coded elements or data(SCD) which
are operationable for computer. The function of ANT is to give the readability for human being rather than the operationability for computer. To simplify, HCSL = SCD $\cup$ ANT.

These efforts lead to a new intelligent pansystem called “Computman”. “Computman” is a kind of Human-Computer complex. Declaratively, the concept of “Computman” is a “person” who can do his intelligent actions through the full cooperations between the EKB in computer and the UKB in his brain. Namely, the Medical Computman is a “person” who owns and fully uses a new type of medical knowledge base HCSL. Formally, Computman = computer(or network)(M) with HSCL + professional user(P) with UKB, where HCSL = CSD $\cup$ ANT, being a new kind of EKB.

Let’s outline our Computman with the most basic analysis(hard-soft analysis) of Pansystems Theory. We know the most basic form of a pansystem is P = (H,S), where H,S means the generalized hard ware and the generalized soft ware, respectively. For “Computman” pansystem, M and P belong to its hard part , HCSL and UKB belong to soft part. Totally speaking, the complete knowledge base, which is necessary for the intelligent actions of human being, CKB = UKB $\cup$ EKB. Because for Computman, EKB
= HCSL, therefore, the Computman’s CKB = HCSL $\cup$ UKB. HCSL is the relative hard part and UKB the

relative soft part. The core “bridge”, i.e. ANT, is the key part which makes UKB and EKB work jointly rather than doing isolatedly, making it essentially be different from any other classical knowledge base. If c⊂CKB, e⊂EKB and u⊂UKB be the logic pathway subsets in CKB, EKB and UKB, respectively, and we have two propositions P1 and P2, then even if P1 o e o P2∉T, P1 o u o P2∉T, It is still possible that we get P1 o c o P2∈T,where T the logic pathway set from proposition P1 to proposition P2. Thus it is possible that we do with the two propostions P1 and P2 jointly rather than isolatedly as traditionally, to finish a one-to-two transformation.

6. The description on the prototype of HCSL

As stated above, IREMB was initiated under the influence of Pansystems Theory. The first explorative paper was published in 1989 with a rather ambitious goal named Quantitatively or Qualitatively Medicine
Simulating and Operating by Computer(QMSOC)[6-15]. It was renamed rather pragmatically by IREMB, which is actually a part of QMSOC. The knowledge infrastructure and the related computer applications were globally named as HCSL for medicine[16-22].

Because of the hand-shortage, money-shortage or understanding-shortage, here we could only present the prototype of HCSL, meaning a possible substantial updates in future. Considering that the concepts, relation or propositions in medicine are of strong relativity depending on the individual context and infiniteness of composition, and any rigorously structured or formatted medical knowledge AI systems will be confront of challenge by polysemants, greyboxes or –elements, blackboxs or –elements, The 2nd version(developed by Qin Liu) of HCSL has taken the following steps:

1. Except the typical medical terminology such as “Meniere disease”, “monilial vaginitis”, “Alaninee aminotransferase(ALT)”, the encoded general elements(non-medicine-special words, NMW), such as “occasionally”, “possibly”, “by guess”, “scope”, “at night”, “in the evening”, “time”, “order”, “imply”, “in the beginning”, “then”, have been introduced, to make HCSL more closed to natural language(NL), which the human brain is fond of. The purpose of it is to fully encourage the participation of human brain in the processes, operations and integration of medical knowledge.
2. Try to mine those potentially machine-operative elements, such as “indication”, “contraindication”, to increase the degree of automation as much as possible.
3. Introduction of nonstructured part of i.e. “descriptive or natural strings” to enhance the readability.
4. In addition to the so called “knowledge driving verbs(KDVs)(or relation-type verbs), the “free-form descriptive verbs” are introduced to increase the readability of HCSL further, whereas keeping the operative ability of KDVs unchanged.

The IREMB medical knowledge base organized with HCSL consists of three parts over all.

1.The elements files which contain the sets of encoded medical knowledge elements.

2.The relation files each of which stores a set of medical knowledge units of one type of relation or KDV. Now in the prototype of IREMB, only ten KDVs have been specified. They are ten Generalized verbs:(pan)creating (CREAT), (pan)increasing (INCRS), (pan)decreasing (DECRS),(pan)containing (CONTN), (pan)passageway (PASTO), (pan)accompanying (COMPN), (pan)transforming (TRANS), (pan)equating (EQUAL), (pan)ordering (PORDR) (pan)irrelating (PNULL). The developer of IREMB is

well aware of that the ten KDVs are by far not enough pragmatically for processes, operations and integrations of medical knowledge.

3.A series of software of application of IREMB, including editing system, maintaining systems, searching systems, automated logic-guided reading functions and other artificial functions.

The medical knowledge units of HCSL is a declarative units. Each unit structurally consists of five parts: subject set, object set, condition set, operative KDV and the “free-form expressive verbs”. Each of the three kinds of sets includes characteristically operative part(i.e. the elements of the sets) and nonoperative part(i.e. the descriptive strings attached to their prepositional elements).

For examples, if we have the units in the CREAT relation (type 4) file:

@{$257 $258}*{&259}~{}%may lead to%! and

@{$482 #more than or equal to 4.14mmol/L#}*{&484}~{}% may lead to%!.

And we have in element file:

#257 synthesis disturbance of DNA<<

#258 anahaematopoiesis<<

#259 shift to the right of neutrophil<<

#482 low density lipoprotein cholesterol<<

#484 coronary heart disease<<

From those data HCSL reads and prints the two units as:

“synthesis disturbance of DNA，anahaematopoiesis-may lead to-shift to the right of neutrophil” and “low density lipoprotein cholesterol-more than or equal to 4.14mmol/L-may lead to-coronary heart disease”, respectively.

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