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Ngoc Nguyen

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Processing Collective Knowledge – Conflict Resolution and Integration Aspects

(*Keynote Speech*)

Ngoc Thanh Nguyen
[1)] Wroclaw University of Technology, Poland
E-mail: ngoc-thanh.nguyen@pwr.edu.pl
[2)] Ton Duc Thang Univerisity, Viet Nam

Abstract. In this talk we will present a framework for integrating knowledge of a collective and processing the inconsistency. The model for inconsistency of knowledge and knowledge integration using different structures like logical and ontological will also be presented and analyzed. We will show that inconsistency plays an important role in the quality of collective knowledge.

Keywords. Collective intelligence, collective knowledge, knowledge integration

1. Collective Knowledge

Nowadays it happens very often that for making a decision we rely on knowledge originating from different and autonomous sources, for example, from experts or Internet. To make the use of this kind of knowledge, one has to integrate it. Taking into account the fact that very often the amount of knowledge is very large and its inconsistency, the integration process is a complex task. To make the process effective, a mechanism for inconsistency resolution is needed to be worked out.

A collective is understood as a set of some intelligent units which are autonomous in decision making. Each of them is assumed to have its own knowledge base and a mechanism for its processing. Collective intelligence, among others, deals with determining the knowledge of a collective which is consistent and complete in the sense that it should contain all elements not belonging to the knowledge of particular collective members, but can be inferred on the basis of knowledge of them. Methods for processing knowledge in collectives are more and more needed because of rapidly increasing of the number of autonomous sources of knowledge, for example in Internet. The knowledge originating from these sources is often inconsistent. For this process the methodologies for conflict resolution and knowledge integration seem to be very useful.

Collective knowledge on some subject is assigned to a collective which members have their own knowledge on this subject. Thus collective knowledge should be determined on the basis of the knowledge of its members. This process is called the integration process. Taking into account the possibility of inconsistency of knowledge

of the collective members one should take care of conflict resolution process during integration. Consensus methods have been proved to be very useful for determining collective knowledge [4], [5].

A general mathematical model based on distance spaces for analysis the dependence of collective members' knowledge on the knowledge of the collective has been proposed in [6], [9]. We have proved that in many cases the quality of collective knowledge is better than the quality of members' knowledge.

2. Inconsistency Aspect of Collective Knowledge

By a conflict situation we understand a set of data versions representing different opinions of collective members on some matter. Methods for conflict resolving depends on the structure of knowledge. In work [5] a general model for processing conflict has been proposed. This model is based on distance space of objects representing knowledge states of collective members. Next a set of inconsistency functions have been defined and analyzed. We have worked out several methods for:

- Conflict resolution in ontology integration on levels of instances, concepts and relationships between concepts [7], [8].
- Conflict resolution for logic structure of knowledge [5].
- Conflict resolution for relational structure of knowledge [5].

In works [6] and [9] we have proved that inconsistency can have an essential influence on the quality of collective knowledge. Concretely, the higher is the inconsistency degree the higher is the quality.

One of very important of collective knowledge is that it is not a normal "sum" of knowledge of its members, but often contains more knowledge. We have defined a function which for each collective assigns a value representing additional knowledge referring to the "sum" of knowledge of collective members.

3. Integration Computing

Integration is a process in which one of the following aspects should be realized:

- Several objects are merged to give a new element representing them.
- Several objects create a union acting as a whole.
- Determining a set of correspondences between on object and another one.

The first two aspects are most important and most popular [1], [2]. The third aspect refers mostly to ontology alignment [10]. In general, it is assumed that all objects to be included in an integration task have the same kind of structures. The kinds of structures mean for example logical, ontological, hierarchical, relational etc. For the first and the second aspects the following general criteria are the most popular [6]:

- All data included in the elements to be integrated should be in the result of integration. This condition guarantees the completeness, that is all information included in the component elements will appear in the integration result.
- All conflicts appearing among elements to be integrated should be solved. It often happens that referring to the same subject different elements contain inconsistent information. The integration result should not contain inconsistency, so the conflicts should be solved.
- The kind of structure of the integration result should be the same as of the given elements.

We have worked out methods for integrating knowledge for the following structures:

- Ontology integration and alignment on levels of instances, concepts and relationships between concepts [10], [12].
- Conflict resolution for logic structure of knowledge [5].
- Conflict resolution for relational structure of knowledge [5].

We have proposed a general framework for integration computing referring to determining collective intelligence [4]. We have shown that in general the knowledge of a collective is more proper than the knowledge of its members. This, in turn, proves that a collective is often more intelligent than single units. Some applications of integration computing methods in managing data warehouse federations and multi-agent systems have been worked out and analyzed [3], [11].

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