SESSION 3
Artificial Intelligence and Knowledge Engineering

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A NATURAL CLASSIFICATION AS A SYSTEMOLOGICAL METHOD FOR KNOWELEDGE MODELLING

The main purpose of the given work is the application of systemological classification analysis method and natural classification criteria for conceptual knowledge acquisition, ontologies and knowledge bases creation. Method based on natural classification helps to investigate deep semantic regularities of subject domain and to take proper account of system-classes essential properties the most objectively. It allows receiving the forecasting parametrical classifications and effective ontologies in different ill-structured problem domains, knowledge management, organizational modelling for companies' sustainable development and competitive advantages providing.

Keywords – natural classification, systemological classification analysis, conceptual knowledge, parametrical classification, ontology, low-formalized subject domain, systemology.

Scientific and technical progress and the development of a world market have led mankind and, in particular, science to realization of the world's integrity, based on the process of formation of the noosphere as a natural stage of development of our planet's biosphere. New problems of state-building and administration and also of informatization, education, and formation of personality have appeared in connection with the changing space and time scales and goals of human activity determined by the world's developing noospheric integrity.

The means of solving such complex and poorly formalizable problems, including organization and improvement of the noosphere, is a new systemological methodology, the result of development of the system approach, is the most promising and efficient in the current conditions. This methodology makes it possible to reveal the essential properties of complex objects of an arbitrary nature, and also the reasons for their occurrence, adaptation, and development, and, consequently, to predict and manage any complex system more efficiently. The quality efficiency of this methodology determines the necessary of its use in application fields of an arbitrary nature, including for construction of a Fig. of the world as a whole [1].

Representation of knowledge as an integrated model of the universe is essential for manipulation of data. Without such a model one cannot speak either of managing the biosphere or of putting in order the informational sphere, or of constructing the noosphere. The search for an integrated Fig. of the universe has become a key principle informatic development of models of subject fields and creation of database, knowledge bases, ontologies [2].

We will describe certain fundamental constructive criteria and a method of natural classification formulated on the basis of the study and modelling of the regularities of the structure of conceptual system, which reflect the systematic character of reality (a subject field) and which you can find in details in [3, 4]. On the basis of these criteria, it is possible for any subject field:

- to construct a classification reflecting essential properties of objects and different aspects of considering them;
- to estimate any classification in terms of the degree of inclusion of essential properties;
- to define errors and inaccuracies of any classification and specify their sources and possible remedies;
- to predict the evolution of any classification;
- to correct the terminology of subject fields.

The criteria are based on the following postulates.

1. Hierarchicity criterion. The structure of reality (subject fields), when considered in a certain specific aspect, is hierarchical. The classification of concept also possesses a hierarchical structure, which reflects the systematic quality of the reality.

2. Monism criterion. The supersystem, which embraces all class systems, must be unique. The classification of concepts has a unique category. This category is the concept of a supersystem.

3. Systematicity criterion. The content of a concept reflects essential functional properties of a system in the supersystem. The scope of a concept represents the supporting properties of the system. The supersystem is reflected in the generic concept. The subsystem in a specific concept. The essential functional property of a system in the specific distinction of the concept.

4. Criterion of properties. Essential functional properties of a system in a supersystem are species of essential functional properties of the supersystem. For concepts, this is tantamount to the following proposition: the specific distinction of a concept of a certain system is a type of a specific distinction of the concept of the supersystem of that system.

The generalization of the third and the fourth criteria leads to the following assertion: the generic-specific classification of concepts of essential functional class properties defines the generic-specific classification of the concepts of class systems that possess those properties.

5. Connectivity criterion. The supporting properties of a system of the *i*-th level are functional properties of its systems, i.e., of the systems of the level $i + 1$. Likewise, for the concepts: the notions of supporting properties of a system of the *i*-th level are concepts of functional properties of subsystem, i.e., systems of level $i + 1$.

Hence, follows.

6. General criterion. Essential supporting properties of any system are essential properties of its subsystem and species of its essential functional property. The concepts of essential supporting properties of a system are the concepts of essential functional properties of its subsystems – the species of the concept of the essential functional property of the system.

7. Multiaspect criterion. Any system has different properties, which may become essential in a certain class of situations (the relatively essential properties). Therefore, any system (or concept) can be viewed from different standpoints (in different aspects). Each aspect corresponds to the functioning of the system in a certain supersystem defined in accordance with the properties of such systems.

A conceptual system is limited to the category and individual concepts. A hierarchy of systems is limited to the supersystem and specific systems. Theses facts should be taken into account in the application of the criteria. A through analysis of a natural classification has established the validity of the criteria for concrete systems as well (individual concepts) if subsystems are defined at functional components of the systems. This fact confirms the important assertion that the classification by “part-whole” principle for concrete systems (functional parts) and the generic-specific classification for external systems (functional genera and species) are essentially analogous and can be viewed in the framework of an integrated natural classification of class systems according to their essential functional properties.

Method of systemological classification analysis on the basis of natural classification has many advantages in comparison with others [3] and has been used for conceptual and ontologies modelling. Ontologies are realized in Protégé and can be used in semantic retrieval in Internet with a help of OWL. Method of systemological classification analysis helped in a basic hierarchy modelling which had used in new systemological technologies [5] and can be used in other artificial intelligence systems.

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