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Modelling of conceptual space of the "regional social potential" term on the basis of fuzzy frames

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Abstract

The article is devoted to problems of formal determining and modelling of the conceptual space of important socio-economic terms. A new approach for conceptual space modelling based on fuzzy frames is suggested. The results of "regional social potential" term modelling are discussed. They afford to come to the conclusion that the use of fuzzy frames allows to structure the investigated conceptual area and also to assess priorities and weights of its attributes with getting well interpretable results

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Keywords: conceptual space of term, fuzzy frames, conceptual space modelling, determination of regional social potential

1. Introduction

Despite the fact that quantitative methods are primarily used in analysis of socio-economic systems, disaffection with solved by their instrumentality problems and limitation of the analytical assumptions is evident. Therefore, in recent years, researchers are increasingly turning to the use of alternative, in particular, non-numerical methods of investigation of complex social systems. The study of non-numerical objects requires appropriate non-traditional forms of their formal representation. Therefore, representation of source data (problem area knowledge) is updated with growing complexity of the modeled domain area.

Weak structuring of the investigated domain area and lack of stable assessments of actual factors and their possible aggregations are main characteristic features of complex systems modelling in general, and regional socio-economic modelling in particular.

In solving problems of knowledge about regional socio-economic systems structuring the main questions are: what knowledge should be presented and in what is its form. The complexity and diversity of knowledge structures showed different ways of knowledge presentation, namely: logic models, frame and production semantic networks.

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Each method has its own methodological strengths and weaknesses. It is therefore quite understandable attempts to use knowledge representation models that combines these methods. And if problem-solving procedures of fairly broad class of problems is based on the so-called "strict algorithms", the knowledge representation models are dealing with information obtained primarily from the experts, which in this case is not only of quantitative nature, but also has qualitative, sometimes contradictory, nature. Therefore there is an objective necessity for determining the degree of adequacy of knowledge representation on the main aspects of the modeled domain area that may be provided under special theoretical approaches, two of which are well defined at the present moment:

- cognitive approach – the direct knowledge representation based on production rules, frames and semantic networks;
- logical approach - based on first-order predicate logic, producing logical conclusions on a strictly formal, theoretical system, based on mathematical formalization and logical completeness.

Cognitive approach, in general, is based on the process of understanding of individual supervising (Lahlou 2008). It is based on the principles of organization of human memory. Therefore, the knowledge representation expressiveness rather than mathematical elegance and rigor is peculiar in this case. And if the exponents of logical approach choose for their research relatively simple problems, the researchers using cognitive approach solve real, relatively complex problems, requiring the introduction of new concepts and new methodologies. In this regard it is useful to recall briefly the existing periodization in development of the approach ideology (Baranov and Sergeev 1990) and the characteristic features of its each stage:

1. N. Wiener ‘s "Black box". The principle of simulation when modeling techniques do not correlate with the actual characteristics of a simulated object. The method has shown its effectiveness in modeling of some simple forms of intellectual processes. The main drawback of the method was formulated in the famous Neumann’s conjecture about the " complexity threshold"; starting with a certain degree of complexity of the modeled object, the model becomes more complex the object itself.
2. The "black" and "white" boxes complex. The same principle but with the ideology of partial transparency, which proved to be more efficient than previous, stimulating in its establishment and development the elaboration of fuzzy criteria (Zimmermann 2010), frame and network methods of knowledge representation, etc.
3. " Knowledge machine" involves the atomistic principle of knowledge representation, on the basis of which a wide class of different (ES) generations with forward and reverse operation was created (and is created where there is a need). This techniques convincingly demonstrated the advantages and disadvantages of logical and cognitive directions in the ways of knowledge representation. At that, methodological limitations in the expert systems ideology were found only in the process of their testing and serial adaptation. It was found too that the fixation of the knowledge representation method fundamentally limits the class of situations in which they can be used in modeling of intellectual processes. In addition, there were cases when a designer used different knowledge to solve the same problem, and to solve different problems - the same knowledge were used.
4. The interpretive ideology, which in its capabilities not only overcame limitations of the atomistic approach. Particular interest in this case was generated by the models of understanding process, which were developed in hermeneutics as a scientific direction in the cognitive science.

2. Fuzzy frames as the approach for definition of conceptual space of the economic term

For achieving their goals the authors of this paper used the concept of frame as the mean of creating a frame (semantic) network. Despite the fact that in the area of artificial intellect there was a transformation of the meaning of the "frame" term, the classical M. Minsky model was used. He understand frame as the minimal description of object or phenomenon, which contains all important information about object or phenomenon and has the property that deletion of any part of the description leads to loss in essential information, without which the description of object or phenomenon may not be sufficient for its identification.

The proposed approach may be more productive if under the slots of each frame or set of frames as a means of description of the studied object or phenomenon we should understand some fuzzy subsets . In this respect, fuzzy frames may be the basis for structuring the investigated domain area in the form of decision tree (DT) and on its basis – the creation of a semantic network, which is the most general model of knowledge representation. The vertices of semantic network are information units, and arcs represent relations between them. The use of its