Implementation of Information Needs of ostis-systems Users

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***Abstract*—The possibilities of knowledge bases of intelligent systems allow you to represent and structure knowledge about the world around you and derive this knowledge about it, thereby satisfying the user's information need. In this paper, the formal specification of the *Question language* for intelligent systems is clarified, which allows describing and interpreting any classes of *questions* of *users of intelligent systems* developed on the basis of OSTIS technology *Keywords*—OSTIS, intelligent system, question language, information need**

I. Introduction

One of the key features of an *intelligent system* is that the *user* has the opportunity to formulate his information need. One of the ways to express such a need is a *question* [1], [2]. In the process of dialog communication, there is always a context that defines additional information that contributes to the correct understanding of the *meaning* of the message. The peculiarity of the presentation of information in the *knowledge bases* of *ostis-systems* simplifies the formation of the user's information needs, since the information presented in the *knowledge bases* is already structured and the relations set on a certain concept are known, in relation to which the questionproblem situation is resolved. The paper [3] shows that the question-problem situation cannot be solved within the framework of formal logic and the nature of the issue can be understood in the system of subject-object relations. Due to the fact that when forming *knowledge bases* of *ostis-systems*, subject-object relations are formed within a given *subject area*, thereby simplifying the expression of information needs by the user by means of SC-code [4].

In order to identify specific types of relations, types of questions and classes of answers in papers [5], [6], the need for semantic classification of question-and-answer texts is justified. At the same time, the conceptual basis for the formalization of questions is the language of questions and erotetic logic [7], which allows you to ask question-answer relations.

Within the framework of this work, fragments of structured texts in SCn-code [8], [9] will often be used, which are simultaneously fragments of the source texts of the knowledge base, understandable to both humans and machines. This allows you to make the text more structured and formalized, while maintaining its readability. The symbol ":=" in such texts indicates alternative (synonymous) names of the described entity, revealing in more detail certain of its properties.

II. The purpose of developing

The purpose of developing ***Question language for ostis-systems*** and its subsequent developing is to implement the possibility of understanding the actions carried out by the *ostis-system* when forming an answer to the question posed. In the process of forming a conclusion to the *question* posed, the following options are possible:

- the answer to this question exists in the *knowledge base* and a *fragment of the knowledge base* is localized in the context of the *user's* information needs expressed by means of *SC-code*;
- the answer is related to the resolution of some problem situation, which is contained in the context of the *question* and the formation of the *answer to the question* is assigned to the *problem solver*.

Question language for ostis-systems
:= [Proposed version of the language for describing questions and answers to them in ostis-systems]
∈ *sc-language*
→ *syntax of language**:
Syntax of Question Language for ostis-systems
⊂ *SC-code syntax*
→ *denotational semantics of language*:*
Denotational semantics of Question language for ostis-systems
:= [Ontology of classes of signs and relations for describing the formulations of questions in SC-code]
⊃ *Semantic classification of questions*
→ *operational semantics of language*:*
Operational semantics of Question Language for ostis-systems
:= [Collective of sc-agents displaying answers

to the questions asked by the ostis-system user]

III. SYNTAX OF QUESTION LANGUAGE FOR OSTIS-SYSTEMS

Question Language for ostis-systems belongs to the family of semantic compatible languages – **sc-languages** and is intended for the formal description of the search prescription of *ostis-systems* in order to meet the information needs of the *user*. Therefore, the ***syntax of the Question Language for ostis-systems***, like the *syntax* of any other *sc-language,* is the *Syntax of SC-Code*. This approach allows you to:

- unify the form of presentation of *questions* and *knowledge,* with the help of which answers to the *questions* posed are built;
- use a minimum of means to interpret the *questions asked by users*;
- reduce the output of answers to most of the *questions* asked to the search for information in the current state of the *ostis-system knowledge base*.

IV. DENOTATIONAL SEMANTICS OF QUESTION LANGUAGE FOR OSTIS-SYSTEMS

Denotational semantics of the Question Language for ostis-systems includes *classes of questions* and corresponding *classes of answers* necessary for the specification of the formulations of *questions* and *answers* to them, as well as *classes of signs* and *relations* included in the structure of any *question*. *Semantic classification of questions* of the *Question Language for ostis-systems* is based on the idea described in the paper [5]. Any ***question*** in *Question Language for ostis-systems* is a *specification of an action* to search for or generate *knowledge* that satisfies the information need of the *user* initiating this *question*. That is, the *question* — is nothing more than a *problem* by which the user's need for some information is expressed, possibly stored or output in the *knowledge base* of the *ostis-system*.

Each *question* can be uniquely correlated with a certain set of *answers to* this *question*. Each *answer to the question* represents a certain *sc-structure* of the *semantic neighborhood of the main sign* disclosed in this *answer to* the *question*.

question
:= [request]
:= [not a procedural formulation of the task of searching (in the current state of the knowledge base) or generating knowledge that meets the specified requirements]
:= [in what way]
:= [request for a method (method) for solving a given (specified) *class of problems* or a *plan for solving* a specific specified *problem*]
:= [problem aimed at satisfying the information needs of a certain customer entity]
⊂ *problem*

answer to the question
:= [response to the request]
:= [query result]
:= [result of solving the problem of finding or generating knowledge that meets the specified requirements]
:= [semantic neighborhood of the *main sign*, the knowledge of which satisfies the information need of the user]
⊂ *knowledge*

Among all classes of *signs within the framework of a given question* of the *Question Language for ostis-systems*, the most common classes of *signs* in the hierarchy can be distinguished:

sign within the framework of a given question
⊂ *sign*
→ *splitting**:
{• *main sign within the framework of the question asked*
:= [key sc-element within the given question]
:= [*sign* about which the question is asked]
• *non-core sign within the framework of the question asked*
:= [*sign* that stands in some relation to the *main sign within the framework of the question asked*]
}

sign within a given question is any *sign of a concept* or *entity* belonging to that *question*. Between the *signs, within the framework of the given question*, a set of relationships of *relations* that are part of various *subject areas* is set. In addition, ***any relation within the framework of a given question*** is a *relation* between the *signs* of the *subject area* belonging to the given *question*. Among all classes of *relations within the framework of a given question*, one can distinguish a class of ***basic relations within the framework of a given question*** and a class of ***composite relations within the framework of a given question.***

attitude within the framework of the question asked
:= [a certain relationship between the signs of the *subject area* in the context of the *question*]
⊂ *attitude*

the basic attitude within the framework of the question asked
:= [*a class of relations* that unites *relations in a given question*, reflecting the same type of *meaning* and revealing a certain feature of the *signs* of the *subject area*]
⊂ *attitude within the framework of the question asked*
→ *decomposition**:
{• *state attitude*
• *action attitude*
• *composition attitude*
• *set-theoretic attitude*
• *temporal attitude*

- *spacial attitude*
- *quantitative attitude*
- *qualitative attitude*

}

For instance, *relations within the framework of a given question*, such as "plays*", "sleeps*", "swims*", are combined into a *class of state relations* on the basis of expressing the state of the *sign* (that is, these relations reveal the feature *sign* of the *subject area* — "to be in some state").

compound relation within the framework of the question asked

:= [a stable combination of two *action attitudes*: an action aimed at the *parameter of the question′*, and an action aimed at *answering the question**]

For instance, an element of a *composite relations within the framework of a given question* between the *signs: "Oil refinery", "oil"* and *"petroleum products"* — can be represented as an "Oil refinery that processes oil into petroleum products".

Semantic classification of *questions* makes it possible to contrast each type of question with a limited set of permissible, in other words, *semantically correct information structures* that convey the correct *meaning* of the *question* depending on the class of the *question.* At the same time, the ***semantic classification of questions*** allows you to divide a lot of *questions* into classes, each of which requires the disclosure of some of the same type of *meaning* given by the class of this *question.*

question

→ *decomposition**:

{• *question requiring the derivation of the semantic neighborhood of the main sign*

∋ *example′* :

- *Question. What is the city of Minsk*

- *question that requires disclosure in the answer of the basic relation of the main sign*

∋ *example′* :

- *Question. Which is lighter: iron or wood*

- *question requiring disclosure of the composite relation of the main sign in the answer*

→ *explanation**:

[This class of *questions* corresponds to the classes of *answers* in which the *main sign* is revealed through a *composite relation.*]

∋ *example′* :

- *Question. What are the principles of component design in intelligent computer systems of the new generation*

- *question requiring disclosure in the answer of an arbitrary combination of the basic relation and/or the composite relation of the main sign*

∋ *example′* :

- *Question. How is the intelligence level of a cybernetic system determined?*

- *question that requires disclosure of more than one main sign in the answer*

∋ *example′* :

- *Question. Prove the Pythagorean theorem*

}

question requiring disclosure in the answer of the basic relation of the main sign

→ *decomposition**:

{• *question requiring disclosure in the response of the composition attitude of the main sign*

:= [a class of questions in the answers to which the *main sign S* is revealed through its *composition attitude* in conjunction with its constituent signs *P* and *Q*]

∋ *example′*:

- *Question. Which administrative districts are part of the City of Vitebsk*

→ *answer to the question**:

{*Zheleznodorozhny district of Vitebsk,*
Oktyabrsky district of Vitebsk,
Pervomaisky district of Vitebsk}

- *question requiring disclosure in the answer set-theoretic relation main sign*

:= [class of questions in the answers