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CALCULATION OF THE PROBABILISTIC-LOGICAL CONCEPTS

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Abstract:
The work deals with one method of calculating probabilistic-logical concepts, which gives us the opportunity to describe any concept in a simpler way. The corresponding algorithm is constructed, which calculates such concepts in dialog mode.

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I. Introduction.

In his works [1,2,3.] V.Chavchanidze posed the idea how to modeling the processes of formation of notion by natural intelligence. For this purpose he introduced a new definition of a set. As it is known, at that time it became obvious that the existing classical definition of a set cannot provide a formal description of the processes proceeding in natural intelligence. It was at this time that L. A. Zadeh proposed his own idea of a linguistic variable [4,5, 6], which herds the basis of the modern theory of fuzzy sets and fuzzy logic.

V. Chavchanidze suggested a little bit another. In particular, according to his theory, there are elements that always belong to the given set ($a \in A$), elements that never belong to the given set ($\overline{a} \notin A$) and elements that sometimes belong to the given set and sometimes no ($\overset{\vee}{a} \in A$). Using this definition of a set, V. Chavchanidze developed a methodology that allows us mathematically (logical) formulate concepts that correspond to the notions of natural intelligence, which was previously impossible to calculate.

II. Formulation of the problem

To form the notion of “a tree”, a natural intelligence must study a certain number of specific trees, after which he abstracts from certain objects and develops an abstract description of a tree, with the help of which he can then recognize as a tree that he has not seen before and also discuss this subject. So if we want to get the formal concept, which is corresponding to a human notion, we should repeat the same way.

In the works of V. Chavchanidze [2, 3, 7], the concept is calculated using the following methodology. In order for the researcher to compute the concept of an object or some process, first of all it must have real, concrete objects corresponding to the notion, the concept of which he computes. Note that a researcher can only have a finite set of real objects corresponding to a given notion (for example, if an architect has to design a house, its objects can be real houses and projects). The researcher describes these objects by attributes and the values of these attributes, wherein the values are conventionally denoted by numbers. Attributes can simultaneously be both qualitative and quantitative.

After such a description, each object is evaluated. It should be noted that the assessment is based on a simple principle: the object either belongs to the concept that we calculate, or does not belong (for example, “this is a house”, “this is not a house”). But it is very important that this assessment be as objective as possible, since it almost completely determines how accurate the concept is.At the next stage, formal binarization of the set of values of each attribute occurs. Each

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set is divided into two parts: elements of one of them are presented by x_{ij} the form and the othersby $\bar{x}_{ij}$ the form. After that, each specific object that is involved in the computation of the concept will be presented as follows:

$$\bar{x}_{i,1}, x_{i,2}, \bar{x}_{i,3}, ..., x_{i.j_m}.$$

Here i marks the number of attribute and j - the number of values. The dash on the top indicates which part of the values belongs to the given value. Between variables is implied the logical operator "and" ($\wedge$).

The combination of objects represented in this form is a concept.To get a complete description of the concept, naturally, combine them with a logical operator “or” ($\vee$).The result is a description of the concept

$$\varphi_+(T) = \bigcup_{l+} \varphi(T^{l_+}).$$

Here l_+ are the objects that have received a positive assessment. Thus, the computed actual concept is a normal disjunctive function.

III. Algorithm for computing of the probabilistic-logical concepts.

This method of calculating the concept has a weak side. When the number of specific objects on the basis of which a concept is calculated is very large, the normal disjunctive function is also large. The minimization of this function requires a lot of time and sometimes the impression is made that the concept is not explicitly expressed.

In order to avoid this moment, we will consider the probabilistic-logic method of computing the concepts.

Suppose we want to calculate the concept of any **S** class objects. These objects are described in their attributes$\times$values space that can be presented as a matrix

$$\begin{pmatrix} a_{11} & a_{21} & \cdots & a_{m1} \\ a_{12} & a_{22} & \cdots & a_{2m_2} \\ \cdots & \cdots & \cdots & \cdots \\ a_{1n_1} & a_{2n_3} & \cdots & a_{mn_m} \end{pmatrix} \quad (1)$$

Before we begin computing the concept, we binaries the value sets of each attribute. Suppose we have N number of objects, which belong to the **S** class. To calculate

$$p_{ij} = \frac{N_{ij}}{N}, \; i = \overline{1,m} \text{ and } \overline{1,n_i}$$

Where N_{ij} there is a number,which shows how many times we have the value in S class objects and N the number of these objects.After such calculations we can change the matrix (1) new matrix (2).

$$\begin{pmatrix} p_{11} & p_{21} & \cdots & p_{m1} \\ p_{12} & p_{22} & \cdots & p_{m2} \\ \cdots & \cdots & \cdots & \cdots \\ p_{1n_1} & p_{2n_2} & \cdots & p_{mn_m} \end{pmatrix} \quad (2)$$

If you sum up $P_i = \sum_{k=1}^{l} p_{ik}$ and $\overline{P_i} = \sum_{k=1}^{t} \overline{p}_{ik}$, where the first is summarized, the probabilities that match the elements a_{ij} and the second are the probabilities, that correspond to the elements $\overline{a_{ij}}$ (obviously, that $P_i + \overline{P_i} = 1$) we get:

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$$\varphi(S) = \begin{pmatrix} P_1, & P_2, & ..., & P_m \\ \overline{P_1}, & \overline{P_2}, & ..., & \overline{P_m} \end{pmatrix},$$

In order to get a logical description of the concept, we have a filtration coefficient ψ, that can be used to determine how important a particular attribute is for the concept.When the filtration parameter is selected, we are starting to transition to the logical representation of the concept. Filtration takes place with following principle: if $P_i \geq \psi$, an i^{th} attribute in logical representation is presented as A_i; if $\overline{P}_i \leq 1-\psi$,an i^{th} attribute in logical representation is presented as $\overline{P}_i$; and if $\overline{P}_i > 1-\psi$, or what is the same as $P_i < \psi$, then an i^{th} attribute in logical representation is presented as $\overset{\vee}{A_i}$. As a result, we gain logical representation of ours concept:

$$\varphi(S) = (A_1 A_2 \overline{A}_3 A_4 \overset{\vee}{A_5} \overset{\vee}{A_6} ... \overset{\vee}{A_m}),$$

Where attributes A_i and $\overline{A_l}$ are important attributes, and where attributes $\overset{\vee}{A_k}$ represent noteworthy attributes. Among the attributes are logical operator “and” ($\wedge$).

Consider an example of using the described method to calculate the concept of a "packing box".Suppose we have a attribute$\times$value space, consisting of 9 attributes and their values (see Table 1). We collected packing boxes in which detergents are sold, and asked to evaluate these boxes on the principle of “good box” and “bad box” to both consumers. We have described these boxes by the given attribute$\times$value space.Then we selected those objects that have received a positive assessment from consumers and calculate relevant concept.

N	Attribute	Attribute title	Attribute values
1	A_1	box's color	1. White; 2. Black; 3. Blue; 4. Red; 5. Green; 6. Brown; 7 yellow; 8. Combined
2	A_2	box's shape	1. Rectangle; 2. Cylinder 3. Conus; 4 shaded cone; The box does not have a solid form.
3	A_3	box's material	1. Paper; 2. Glass; 3. cellophane; 4. Plastics; 5. Cardon.
4	A_4	box weight	1. $\leq$0,5 kg; 2. 0,5 to 1 (kg); 3. 1$\leq$ (kg)
5	A_5	information printed on the box Full	1. information about the name, weight, composition, exploitation, use of sphere and weigh 2. Information about the name, the sphere of use and the weight Only name and weight
6	A_6	Moisture box stability	1. Protects from the Moisture; 2. Does not protect against Moisture;
7	A_7	degree of box hardness kg / cm^2	1. 0,5 kg; 2. 0,5 to 1 (kg); 3. 1 (kg)
8	A_8	Box's volume (ds^3)	1. $2ds^3 \leq 3ds^3$. 2. $3ds^3 > 3$
	A_9	Is this detergent available in a different package?	1. Yes; 2. No.

Table 1

We divided sets of the values by the following way:

$A_1 - (1,2,3,4,5,6,7,\overline{8})$; $A_2 - (1,2,3,4,\overline{5};)$ $A_3 - (1,2,3,\overline{4}.\overline{5},\overline{6})$; $A_4 - (1,2,\overline{3})$; $A_5 - (1,\overline{2})$; $A_6 - (1,\overline{2})$; $A_7 - (1,2,\overline{3})$; $A_8 - (1,\overline{2})$; $A_8 - (1,\overline{2})$.

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After the calculating we get following concept:

$$\varphi(S) = (A_2 A_3 A_8 A_{11} \overline{A_{12}} \; A_1 \; \check{A}_5 \; \check{A}_6).$$

IV. Conclusion

Such a description is easily perceived and allows us to let's choose which attribute are important for the user and which ones do not. Consequently, if we change the values of those attributes that are not important for the user, we will get a wide variety of products, while maintaining important attributes guarantees that the product will be sold.

Such a description of the natural intelligence notions can be applied in many areas of human activity that will allow to using the computer even more widely for solving complex intellectual problems.

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