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НЕЗАВИСИМОЕ КОМПЬЮТЕРНОЕ ПРЕДСТАВЛЕНИЕ ПРОСТРАНСТВЕННЫХ ОТНОШЕНИЙ В КЫРГЫЗСКОМ ЯЗЫКЕ

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Показаны особенности выражения пространственных отношений и их использование для независимого компьютерного представления соответствующих терминов в кыргызском языке.

Ключевые слова: кыргызский язык; пространственное отношение; компьютерное моделирование.

INDEPENDENT COMPUTER PRESENTATION OF SPATIAL RELATIONS IN THE KYRGYZ LANGUAGE

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The article describes the peculiarities of expression of spatial relations and their application for independent presentation of corresponding terms in the Kyrgyz language.

Keywords: Kyrgyz language; spatial relation; computer modeling.

Introduction. Nowadays computer equipment is commonly used in studying foreign languages. To build software for studying and testing natural languages, we began to combine the following ideas: studying language without intermediate language; constructing of random assignments; availability for philologists who may develop exams and electronic study books without the help of software developers.

Computer-based system “Language Education System” (LES) that joins these ideas was developed in [1]. LES is based on the independent computer representation of natural languages’ notions [2], [3].

In [4] authors proposed representation of complex notions. For that necessary entities (such that 1D, 2D, 3D spaces, motion, animation, avatar, transformation etc.) should be used.

In [5] presentation of one kind of specific words in Kyrgyz language was proposed.

1. Main definitions and hypotheses. In [6] it was proposed to develop independent computer representation of natural languages on the base of the following

Definition 1. If low energetic outer influences can cause sufficiently various reactions and changing of the inner state of the object then it is said to be an affectable object, or a subject, and such outer influences are said to be commands (these reactions and changing are implemented by means of inner energy of the object or of outer energy entering into object besides of commands).

Remark 1. In programming languages, statements are divided into declarations and commands usually. But all declarations also may be considered as commands. Also, narrative and interrogative sentences in natural languages also are implicit imperative ones.

Definition 2. A system of commands such that any subject can achieve desired sufficiently various consequences from other one is said to be a language.

These definitions unite humans and computers and their languages.

Remark 2. The other subject may be the same. For instance, a person being afraid of forgetting writes down an instruction or a list for her/himself to use it in future.

Hypothesis 1. A human's genuine understanding of a text in a natural language can be elucidated by means of observing the human's actions in real situations corresponding to this text.

Definition 3. Let any "notion" (word of a language) be given. If an algorithm acting at a computer: performs (generated randomly) sufficiently large amount of situations covering all essential aspects of the "notion" to the user; gives a command involving this "notion" in each situation; perceives the user's actions and performs their results clearly on a display; detects whether a result fits the command, then such algorithm is said to be a computer interactive presentation of the "notion".

In general, the environment for the user consists of (generated randomly) constant objects, mov-

ing-transforming objects and controlled objects. Random generation of auxiliary objects and their positions is necessary to distinguish the "notion" among other words being used in the command and arising circumstances which are not sufficient for the "notion".

Remark 3. Certainly, commands are to contain other words too. But these words must not give any definitions or explanations of the "notion".

Definition 4. If all words being used in Definition 3 can be unknown for the user nevertheless s/he would be able to fulfil the meant action (because it is the only natural one in this situation) then the notion (word of a language) is said to be primary. If any words known to the user are necessary then the notion is said to be secondary.

Thus, a natural hierarchy of notions arises.

By our experience, verbs PUT, TAKE, PUSH, COMPLETE, ENTER, GO OUT, OPEN, CLOSE, SYMMETRIZE and simple nouns such as BALL, STICK, BOX are primary.

Remark 4. Modern displays are formally discrete but they are perceived as continuous. So, continuous motion and transformations can be implemented.

Usually a notion is defined as a mental image or representation. But there is a more definite hypothesis in pattern recognition: various images corresponding to a same notion form a “compact” set (the term “compact” is understood informally). In [6] it was proposed

Hypothesis 2. A child or a human learning a natural language without references to known languages hearing a notion in various situations begins to form a kind of mathematical model in mind corresponding to this notion by means of trial and error method and attempts to fulfil operations similar to mathematical ones: closing and compactification. After successful completing such operations, the human feels “mastering” this notion.

Hypothesis 3. Any notion has the minimal model (involving minimal number of entities in Occam’s sense). These entities can be mathematical involved into such verbs as geometry (ЖЫЛДЫР - MOVE), topology (КЕС - CUT), three-dimensional space (ИЙ-FLEX, ТҮЙҮН-KNOT), physical (ТАМЧЫЛА-DROP, КАЙНА-BOIL, ТОҢДУР-FREEZE), chemical (ӨРТТӨН-BURN), affectable (БЕР-GIVE, КӨРСӨТ-SHOW, УК-LISTEN, HEAR), etc. We use the term “affectable” instead of “animated” because it is related to computers as well as to humans and animals in present-day speech.

Remark 5. From this point of view, chemical essences unite with some physical ones into “sufficiently transforming” ones.

Hypothesis 4. Up-to-date multimedia computer equipment is sufficient to model situations necessary to teach and detect genuine understanding of vital notions in natural languages.

2. Peculiarities of spatial relations in Kyrgyz language. Peculiarity of Kyrgyz language is those parts of space related to any object from the viewpoint of the subject and taking gravitation and direction of observation and motion in account are presented as nouns, with corresponding cases: Dative, Locative, Ablative, Accusative.

YCT(Y) – upper-space, АСТ(Ы) – before-and-lower-(observed)-space, ИЧ – interior, СЫРТ – exterior, ЧЕК – boundary-strip, СОЛ – left-space, ОҢ – right-space, ОРТО – middle-spot, ЖАКЫ – near-space, АРА – between-space, АЛД(Ы) – before-forward-space, АРТ – behind-space.

For example:

The lamp is over the chair – ЧЫРАК ОТУРГУЧТУН YCTYНДӨ – (literatim)

The lamp (is) in the chair’s upper-space.

3. Mathematical and computer models’ definitions. Definitions of mathematical and computer models of natural language’s notion were developed to implement the independent representation of natural languages [7]. Sets theory was chosen as a mathematical apparatus because the natural languages’ notions can be considered as the actions with objects mathematically represented by connected sets.

Definition 5. Mathematical model of natural language’s notion is:

- the list of sets, some of which are the subsets of other sets from this list, with the groups of sets for random choice;
- the list of possible motions and other transformations of these sets;
- the lists of allowable and unallowable relations between sets during their transformations;
- the list of necessary relations (intersection, embedding) in the time sequence;
- the list of assignments including the notion, that give its sufficiently complete and adequate representation.

Definition 6. Computer model of natural language’s notion is the model based on the mathematical model of this notion with graphical representation of sets.

Example 1. Mathematical model of the notion YCT(Y) – upper-space.

The media where the notion is demonstrated is the two-dimensional geometric space $(0<x< X, 0< y <Y)$.

Sets: K is the cursor (controlled point), two sets of objects: $U=\{T_i \mid i=1..n\}$ (little things), $D = \{P_j \mid j=1..m\}$ (big things).

$p:=random(1..n); q:=random(1.. m)$.

Assignment: «T_p -НЫ P_q -НЫН YCTYНӨ КОЙ».

T_p is movable; other sets are constant.

Necessary relation: if $K \in T_p$ for any moment then $K \in T_p$ for all subsequent moments.

Unallowable relations: intersection of two distinct elements of $U \cup D$ is not empty.

Initial position: all $y(T_i)$ and $y(P_j)$ are approximately equal to a number Y_1 close to 0.

Resolving conditions: $\exists$ moments $t_0 < t_1$:

t_0: $(K \in Tp) \wedge (y(Tp) = Y1)$;

t_1: $(y(Tp) > y(Pq))(x(Tp)\ x(Pq))$.

4. Computer model implementation. In [5] authors suggested a computer program that demonstrates spatial relations in Kyrgyz language.

The following program teaches user to understand meaning of the notion YCT assuming user knows other notions in the command:

1) The computer (randomly) constructs sets of Things "U" and of Places "D" by choosing corresponding objects from the database; (randomly) chooses spatial relation.

For example, "ЧЫРАК" $\in$ U, "ОТУРГУЧ" $\in$ D, YCT is spatial relation.

2) The computer detects affixes for text assignment:

ЧЫРАК+Accusative-case-affix ОТУРГУЧ+Genitive-case-affix YCT+Possessive-affix+Dative-case-affix КОЙ. (There are corresponding algorithms in Kyrgyz language.)

ЧЫРАК+НЫ ОТУРГУЧ+НЫН YCT+Ы+НА КОЙ.

3) The computer gives the graphical situation (objects on the screen) and the text:

"ЧЫРАКТЫ ОТУРГУЧТУН YCTYНӨ КОЙ."

("Put the lamp in the chair's upper space." or "Put the lamp on the chair.")

4) In case of unallowable relations (see **Example 1**), computer responds "ТУУРА ЭМЕС" ("Wrong") and returns objects to their initial positions.

5) In case of necessary relations (see **Example 1**), computer responds "ТУУРА" ("Correct") and finishes the assignment.

Such computer programs can be developed for teaching spatial relations in Kyrgyz language.

Conclusion. We hope that mathematical and further computer modeling approach would be useful for profound investigation of Kyrgyz language. Computer systems that are based on the mathematical and computer models of notions can be used for teaching Kyrgyz language. Suggested construction of spatial notions' models is a significant part of independent computer presentation of Kyrgyz language.

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