Mathematical Software For Creating A Trilingual Electronic Translator Between The Languages Of The Turkish-Language Family

Elmira Nazirova¹, Shakhnoza Abidova², Khurshida Karabayeva³, Mamura Uzakova⁴

¹Head of the Department of Multimedia Technologies, DSc,Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Tashkent, Uzbekistan,
Email: elmira_nazirova@mail.ru
²PhD of the Department of Multimedia Technologies, Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Tashkent, Uzbekistan, Email: shaxnoza23@mail.ru
³Assistant of the Department of Multimedia Technologies, Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Tashkent, Uzbekistan, Email: khurshida56@mail.ru
⁴PhD student of the Department of Multimedia Technologies, Tashkent University of Information Technologies named after Muhammad al-Khwarizmi, Samarkand, Uzbekistan,
Email: yulduzxon2626@gmail.com

ABSTRACT
This article is devoted to the mathematical software of a trilingual electronic translator between the Uzbek, Karakalpak and Turkish languages belonging to the Turkic language family, based on the above schemes, a mathematical model was created to create simple and complex word formation in the Uzbek, Karakalpak and Turkish languages.

Keywords: electronic translator, uzbek, Karakalpak and turk language, mathematic model.

INTRODUCTION
In the era of modern technology development, automation of each area is one of the requirements of the time, that is, the development of electronic translators, which are part of computational linguistics, is one of the topical issues. Based on this relevance, many electronic translators are being developed to make translations from one language to another more convenient and save them time.

When introducing electronic translators, first of all, it is necessary to pay attention to the language structure of the languages in which the translation process is carried out, that is, the language family is of great importance here. Therefore, in this article we will consider the creation of an electronic translator between the Uzbek, Karakalpak and Turkish languages, which are part of the Turkic language family, and the structure of these languages.

The principle of operation of electronic translators works with special attention to word formation, language grammar, morphology and, of course, semantics.

First of all, let us consider Baskakov's scheme of the origin and structure of the Turkic languages.Ease of Use As can be seen from this diagram, the Uzbek language belongs to the Karluk group of the Turkic language family, the Karakalpak language to the Kipchak group, and the Turkish language to the Oguz group.
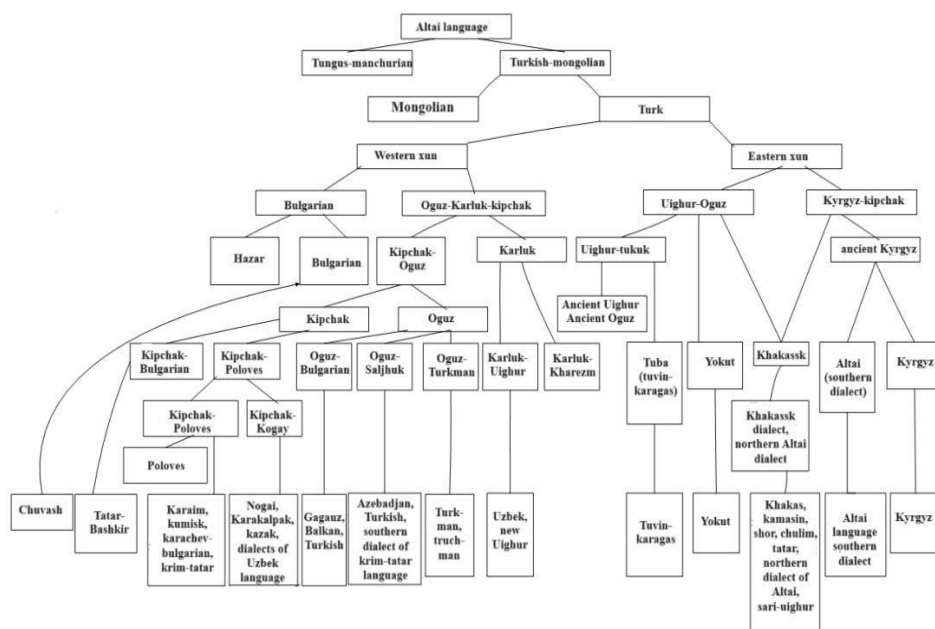
If we analyze the grammatical structure of these languages, then all three languages belong to the group of agglutinative languages, that is, the process of word formation
in these languages is carried out by adding affixes to the main word. At the same time, it is advisable to implement the translation process using a semantic translation model, that is, the translation process is carried out by dividing words into semmas, tokens and lemmas, and searching for words in the database is convenient.

The semantic model of translation is a theory of translation that provides a comparison of the originality of words and translation components. The semantic model of translation can explain the reasons for the existence of semantic inconsistencies between the original text and the translation, showing the factors influencing the translator's choice of one or another translation option.

The English researcher J. Catford, on the basis of his research, studied the application and differences of the semantic model in the process of translating from English into Russian [2].

In addition, V.N. Komissarov noted some shortcomings of the semantic model developed by Catford. According to him, this does not explain the cases when different semantic categories are used to describe a similar phenomenon or state of the surrounding reality in different languages: for example, "instant coffee" - "instant coffee"; translation often does not consider the problem of conveying figurative associations that are not the same in different languages, as well as the possibility of using language units in a figurative sense [2].

As can be seen from this diagram, the Uzbek language belongs to the Karluk group of the Turkic language family, the Karakalpak language to the Kipchak group, and the Turkish language to the Oguz group.

If we analyze the grammatical structure of these languages, then all three languages belong to the group of agglutinative languages, that is, the process of word formation

in these languages is carried out by adding affixes to the main word. At the same time, it is advisable to implement the translation process using a semantic translation model, that is, the translation process is carried out by dividing words into semmas, tokens and lemmas, and searching for words in the database is convenient.

The semantic model of translation is a theory of translation that provides a comparison of the originality of words and translation components. The semantic model of translation can explain the reasons for the existence of semantic inconsistencies between the original text and the translation, showing the factors influencing the translator's choice of one or another translation option.

The English researcher J. Catford, on the basis of his research, studied the application and differences of the semantic model in the process of translating from English into Russian [2].

In addition, V.N. Komissarov noted some shortcomings of the semantic model developed by Catford. According to him, this does not explain the cases when different semantic categories are used to describe a similar phenomenon or state of the surrounding reality in different languages: for example, "instant coffee" - "instant coffee"; translation often does not consider the problem of conveying figurative associations that are not the same in different languages, as well as the possibility of using language units in a figurative sense [2].

Among foreign scientists working on languages belonging to the Turkic language family, and among them electronic translators, Azerbaijani scientists A. Abbasov and A. Fattulaev analyzed the use of syntactic and semantic valencies in the translation of word combinations [6]. Turkish scientists A. Ch. Tantug, E. Adali, K. Oflazer conducted scientific research on the morphological analysis of words between Turkic languages [7].

The semantic model of translation considers the translation itself as the selection of semantic elements in the original text and the selection of learning units of the language containing the same characters.

At the same time, not all elementary meanings, symbols are appropriate in this communicative act and therefore are not transmitted during translation. For example, "All factory workers arrive on time." "All

workers" are men and women, so gender is completely unnecessary when translating this sentence, that is, communicatively it does not matter.

Thus, according to this model, only communicatively significant meanings in a given situation are transmitted in translation, since translation equivalence is based on the commonality of the meanings of the translation and the original.

Based on the foregoing, below we will consider the sequence of word formation between languages belonging to the Turkic language family, that is, Uzbek, Karakalpak and Turkic languages.

The morphological basis of the Uzbek language is characterized by a large number of suffixes, affixes, which are added to the base of the word in a certain sequence and give it different characteristics, as well as a large number of verb forms that allow the creation of up to 150-200 variants, sometimes radically different, but at the same time formed from the verb.

The Uzbek language also has a prefix that is added to some words before the root of the word.The Karakalpak language belongs to the agglutinative languages. "One of the effectiveways of forming grammatical forms for agglutinative languages is affixation, that is,the attachment or non-attachment to the root of the word of grammatical particles -suffixes, through which the word is formed or declined."

For example: jala-slander, jala+ kar - slanderer, bala - child, bala + lyk - childhood, cotton - cotton, cotton + shylyk -cotton growing, bass - head, bass + kar - manage, many - many, many + hey – multiplyThere is a certain pattern in adding word-building suffixes to the root or stem of a word:first, lexical and grammatical word-building suffixes, which make up the maingrammatical categories of word combinations, are added to the stem, and thenfunctional-grammatical suffixes. derivational suffixes.In Turkish lexicology, the semantic (lexico-semantic) way of word formation is theseventh way of word formation in Turkish (after affixation, composition, phonetics,abbreviation, reduplication and conversion). When creating a word by the semantic(lexico-semantic) method, a new word is created based on the change in the meaningof the word.In Turkish, affixes are multifunctional and have several meanings, for example, thecase affix -dan / -den (masadan - table, evden - house) can indicate a causal relationship(Ali şeliktan çok zaıfaldi. - Ali is very weak from illness).The Uzbek, Karakalpak and Turkish languages belong to the agglutinative languagegroup of the Turkic language family, that is, the word is formed by adding derivationalsuffixes to the root word.

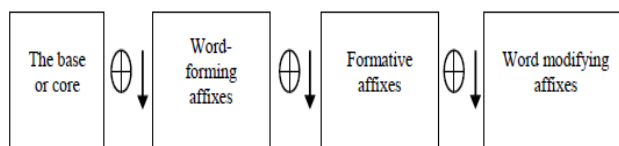Words in the Uzbek language are formed according to the following scheme:

Figure 1. Word formation scheme in Uzbek

Based on Figure 1, we have developed a mathematical model of complex wordformation in the Uzbek language.

$$C = \sum_{i=1}^{n} x_i \oplus\downarrow \sum_{j=1}^{m} a_i \oplus\downarrow \sum_{k=1}^{l} f_k \oplus\downarrow \sum_{r=1}^{q} p_r$$

Here C – complex word, $\sum_{i=1}^{n} x_i$– vocabulary base where each word x is a set, $\sum_{j=1}^{m} a_i$– word-forming affixes, $\sum_{k=1}^{l} f_k$– formative affixes, $\sum_{r=1}^{q} p_r$– word, modifying affixes, here i, j, k and r – affixes and word length; $\oplus$– the act of combining,$\downarrow$– "link" (characters denoting merge or "unlink" (no merge) operations).
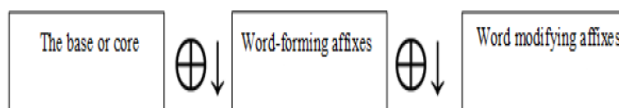

Figure 2. Scheme of the formation of compound words in the Karakalpak language

Based on Figure 2, a mathematical model for the formation of compound words in theKarakalpak language was developed in the following form.

$$C = \sum_{i=1}^{n} x_i \oplus \downarrow \sum_{j=1}^{m} a_i \oplus \downarrow \sum_{k=1}^{l} f_k$$

Here C – complex word, $\sum_{i=1}^{n} x_i$ – vocabulary base where each word x is a set,
$\sum_{j=1}^{m} a_j$ – derivational affixes, $\sum_{k=1}^{l} f_k$ – formative affixes, here i, j, k – affixes and word length [5].
The word formation scheme of the Turkish language is as follows:
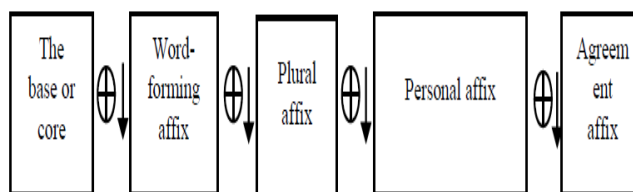

Figure 3. Scheme of word formation in Turkish

Here, also, based on the scheme shown in Figure 3, a mathematical model for theformation of compound words in Turkish was developed as follows.

$$T = \sum_{a=0}^{b} w_a \oplus \downarrow T = \sum_{c=0}^{d} y_c \oplus \downarrow \sum_{e}^{f} k_e \oplus \downarrow T = \sum_{g=0}^{h} l_g \oplus \downarrow T = \sum_{p=0}^{s} t_p$$

Here T – complex word, $\sum_{a=0}^{b} w_a$ – each word w is a set of words, $\sum_{c=0}^{d} y_c$ – wordformingaffixes, $\sum_{e}^{f} k_e$ – plural affixes, $\sum_{g=0}^{h} l_g$ – possessive affixes, $\sum_{p=0}^{s} t_p$ – agreement affixes.
Here a, c, e, g and p – affixes and word length. Here $\oplus$ – the act of combining, $\downarrow$ – symbols denoting the actions of "connecting" (uniting) or "not connecting" (nonuniting)[6].

CONCLUSION
The developed mathematical models are used to create simple andcomplex words in Uzbek, Karakalpak and Turkic languages. The developedmathematical model can be used in other languages that are included in theagglutinative group of Turkic languages.

REFERENCE
[1] Нуралиев, Ф.М., Абидова, Ш.Б. Икки тилнинг семантик таҳлили. -ТАТУ хабарлари журнали. -Т.: 2017, №3(40). -113-117 б.
[2] В.Н.Комиссаров. ОБЩАЯ ТЕОРИЯ ПЕРЕВОДА. Учебное пособие. стр.17
[3] Elmira Nazirova, Shakhnoza Abidova, Shaxnoza Obidova. Mathematical model and algorithm of simple words and simple sentences in the Uzbek language // 2021 International Conference on Information Science and Communications Technologies (ICISCT). Date Added to IEEE Xplore: 17 January 2022. DOI: 10.1109/ICISCT52966.2021.9670202
[4] E. Sh. Nazirova, Sh. B. Abidova, and Sh. Sh. Yuldasheva. Electronic Dictionary and Translator of Bilingual Turkish Languages// The 13th International Conference on Intelligent Human Computer Interaction (IHCI-2021) December 20-22 2021 y. (Scopus). J.-H. Kim et al. (Eds.): IHCI 2021, LNCS 13184, pp. 39–49, 2022.
[5] Kurbonov N., Abidova Sh., Obidova Sh. THE ROLE OF ELECTRONIC TRANSLATION FOR TURKISH LANGUAGES // Problems of computational and applied mathematics. №2/1 (40) 2022 йил. 138-142 бет.
[6] Nazirova E., Nematov A., Sadikov R. Nabiyev, I. Mathematical Modeling of the Nostational Filteration Process of Oil in the System of Oil Deposits Related to Slow Conductor Layers // Lecture Notes in Computer Science 2022, 13184 LNCS, pp. 511–519
[7] Nematov A., Nazirova E.Sh., Sadikov R.T. On numerical method for modeling oil filtration problems in piecewise-inhomogeneous porous medium // IOP Conference Series: Materials Science and Engineering, 2021, 1032(1), 012018
[8] Nazirova E.Sh., Sadikov R.T., Nematov A.R., Ismailov Sh.R. Visualization of the Results of Computing Experiments for Monitoring and Analysis of Filtration Processes in A Non-General Layer of Oil Fields // International Conference on Information Science and Communications Technologies: Applications, Trends and Opportunities, ICISCT 2021, 2021
[9] Nazirova E., Nematov A., Sadikov R., Nabiyev I. One-Dimensional Mathematical Model and a Numerical Solution Accounting Sedimentation of Clay Particles in Process of Oil Filtering in Porous Medium, 2021, 12615 LNCS, pp. 353–360
[10] https://www.researchgate.net/publication/220874083
[11] https://www.researchgate.net/publication/264238118_The_use_of_syntactical_and_semantic_valences_of_the_verb_for_formal_delimitation_of_verb_word_phrases