

Synonymizer of the Ukrainian Language: Stage of Creation, Features of a Database Update and Software Implementation

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Abstract

In the study of the highlighted stage of creating a synonymizer of the Ukrainian language - a computer program that replaces words as synonyms in texts in the Ukrainian language. Before allowing the participant to choose synonyms from the list of suggested. The main stages of creating a synonymizer are: 1) analysis of available synonymizer programs in other languages; 2) problem statement; 3) compiling a register of synonyms of the Ukrainian language based on authoritative lexicographical works; 4) database design; 5) test filling of the database; 6) Python implementation program; 7) construction of the visual interface; 8) testing of the created computer product. The structure of the database "Synonyms of the Ukrainian language" is defined, which includes 5 interdependent tables. Peculiarities of representation in the database of polysemous words and homonymous words are shown. Prospects for further research, in particular, the involvement of synonymous transformations at the sentence level (sentence transformation, sentence conversion, etc.).

Keywords 1

Database, homonym, lexicography, polysemous word, synonym, synonymizer, Ukrainian language, vocabulary

1. Introduction

In modern applied linguistics an important place is occupied by research on various aspects of automatic processing of natural speech. Significant experience has been gained in creating computer programs for text conversion of various types, in particular, text editing, text annotation, text abstracting, text translation in / other languages, etc. [1, 3]. An urgent task today is to create synonymizers - computer programs that replace words or constructions with synonyms in texts and are typically used when writing texts by authors, as well as for rewriting. Such programs can also be used as a reference system for anyone who is learning a certain language or wants to improve their knowledge. We do not know synonymizers on the material of the Ukrainian language, therefore the offered research has scientific novelty.

The purpose of this study is to create a synonymizer based on the Ukrainian language.

The practical significance of the study lies in the possibility of further development in this direction, the use and improvement of software for converting Ukrainian texts to give them uniqueness, in particular when filling sites with content, and to study the richness of Ukrainian and native speakers.

When creating a computer program, we proceed from a broad approach to the qualification of synonyms, by which, following O. Taranenko, we mean "words or their meanings (in polysemy), as well as stable phrases, affixes, word-forming types, grammatical forms, in including syntactic constructions, which in case of full or partial formal difference have identical or almost identical meanings (with possible differences in stylistic and grammatical characteristics and incompatibility)"

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[6: 945] (author of the afterword to the dictionary of synonyms of the Ukrainian language - O. Taranenko).

According to this approach, there are several types of synonyms for different parameters (I. Kobozeva, M. Kronhaus, V. Levitsky, O. Taranenko, etc.):

1. By completeness / incomplete coincidence of values - absolute (complete) and partial (incomplete): *родина* and *сім'я*; *іти* and *шкандибати*.

2. By the presence / absence of semantic differences and stylistic restrictions on use - semantic, stylistic, and semantic-stylistic: *говорити*, *мовити*, *розмовляти*, *казати*, *лопотіти*, *базікати*, *балагурити*, *паякати*, *пащекувати*, *перебендювати*, *теревенити*, *промовляти*, *ректи*, *цідити*, etc.

3. By morpheme features - multi-rooted and single-rooted: *активний*, *пасивний* and *неактивний*.

4. By the presence / absence of the influence of the context on the meaning - common and contextual: *сторіччя* and *століття*; *холодний*, *відсторонений* and *сумний* (state of mind).

5. By the presence / absence of connecting restrictions: lexical and grammatical (syntactic) synonyms: *абетка* and *алфавіт*; *закритий* and *зачинений* (about windows, doors) [6, 9, 12, 24, 27].

It should be noted that a broad vision of synonymy is inherent not only in Ukrainian studies but also common in world practice [5, 11]. In particular, B. Hadumod in the Routledge Dictionary of Language and Linguistics considers absolute and partial synonyms and emphasizes operational methods for checking the degree of similarity in the meaning of two or more linguistic expressions: "The following constitute operational processes for determining the degree of lexical synonymy: the substitution test, which determines the substitutability of synonymous lexemes in sentences of identical syntactic structure; distribution analysis, which establishes the distributional limits in particular contexts; and componential analysis, which provides descriptions via identical bundles of semantic features. Even greater exactness in describing the denotative aspect of synonymy is achieved through the definition for formal logic according to which synonymy corresponds to an equivalence relation: Two expressions E_1 and E_2 in the same syntactic position are synonymous if E_1 implies E_2 and E_2 imply E_1 " [5: 1165].

Complete identity of the content of language units is a rather rare phenomenon. It is generally accepted that most synonyms in any language belonging to a group of partial synonyms, ie synonymous words or synonymous words and constructions have certain differences that may relate to different aspects of content. In particular, the team of researchers led by Yu. Apresyan [29, 30] emphasizes the distinction between absolute synonyms (those that have no differences) and quasi-synonyms (those that may have the semantic, reference, communicative, syntactic, connective, morphological, and/or millet differences).

This aspect is extremely important when creating a synonymizer, as not all words can be replaced automatically without reservations (taking into account the context or style restrictions, etc.), so it is necessary to provide the user with the ability to view relevant notes (remarks) and independently choose from the proposed list of synonyms. Note also that different types of partial synonyms have different terminological designations in theoretical and lexicographical works, which is due to both the peculiarities of the views of researchers and terminological traditions within different linguistic schools.

2. Methods

Methods of analysis and synthesis, descriptive method, component analysis and distributive analysis were used to create the synonymizer. The program was developed using the Python 3.x programming language. Tkinter, CSV was used for the test version of the application. In further work, it is planned to use the open-source relational database management system MySQL, so a relational database model was created.

3. Results and Discussion

3.1. Stages of creating a synonymizer

The process of creating a synonymizer as a computer program is a rather complex process that includes several stages:

1. Analysis of available synonymizer programs in other languages.
2. Problem statement.
3. Compiling a register of synonyms of the Ukrainian language based on authoritative lexicographical works.
4. Database design.
5. Test filling of the database.
6. Software implementation using Python.
7. Construction of the visual interface.
8. Testing of the created computer product.

It is only natural that before creating our computer program, we analysed the synonymizer programs available on the Internet. The vast majority of available programs are based on English or Russian [3, 16, 18, 19, 21, 23, 25].

The analysis of computer products made it possible to highlight the following features:

1. Type (version) of the program (synonymizer can be an application program that must be installed on a personal computer, online service, or mobile application).
2. Automatic, manual or mixed mode of substituting words for synonyms (i.e. some programs involve a person in the choice of synonyms, and those that do not have such an option).
3. Consideration / disregard of morphology (presence / absence of lemmatizer).
4. Presence / absence of a database of exceptions (constructions that cannot be replaced due to various reasons, first integrity of value and connecting features).
5. Taking into account / not taking into account when replacing the word the linguistic-statistical law of Zipf (George Kingsley Zipf), according to which frequency words should be replaced by frequency words, and rarely used - rarely used.
6. The presence or absence of a report on the work performed (start time, end time, the number of processed words, the register of replaced words, the list of used synonyms, the percentage of replacements).
7. The availability of additional options (for example, highlighting words that have synonyms, to attract the user's attention, the ability to choose from several proposed databases, etc.).

We try to take these parameters into account when creating our program.

In the second stage, it is determined that we aim to create an experimental version of the synonymizer for Ukrainian-language texts, which requires installation on a personal computer, provides a mixed-mode of substituting words for synonyms, contains a database of exceptions and can colour words with synonyms. However, as will be shown below, in the process of testing the created program, the authors changed the task, as they concluded that it is possible in principle only to manually select synonyms by the user. It turned out that the data on synonyms available in dictionaries today is not enough for the correct automatic replacement of words in the text.

In the future, this product should be available online, should take into account the morphology and automatically generate a report on the work done.

In Ukraine, there is considerable experience in the lexicographic processing of various lexical oppositions, including synonyms, so when compiling a register of synonyms, we seek to take into account the achievements of modern lexicographers. The register was formed by combining all language units presented in three authoritative dictionaries: the Dictionary of Synonyms of the Ukrainian Language in Two Volumes (2001), the Practical Dictionary of Synonyms of the Ukrainian Language by S. Karavansky (2014) and the Dictionary of Synonyms of the Ukrainian Language by O. Vusyk (2013) [6, 17, 20]. Despite some differences in approaches to the macro- and microstructure of the dictionary, such a combination makes it possible to obtain a fairly complete register of synonyms of the Ukrainian language.

3.2. The structure of the database "Synonyms of the Ukrainian language"

Important and painstaking steps in creating a synonymizer were the design of the database and its test content. After several attempts to build a database, we settled on a database structure that includes 5 interconnected Excel spreadsheets.

Table 1 presents all the words of the Ukrainian language that have synonyms and are recorded in the dictionaries analyzed by us. Table 1 contains 5 columns: "#", "Word", "Interpretation", "Status" and "Characteristic". Insertion column "Status" reasoned that practice showed lexeme describing the need for differentiation status word as submission database definitive words polysemantic words and homonyms are different.

The simplest case is to display unambiguous words in the database. Let's show this with the example of a pair of synonyms *мовознавство* and *лінгвістика* (see Figure 1).

In the column "Characteristic", if available, provide information about the stylistic affiliation, normative / non-normative (dialectal, obsolete, colloquial, etc.) words. For a *мовознавство* and *лінгвістика*, these cells remained empty.

#	Слово	Тлумачення	Статус	Характеристика
ID_01	лінгвістика	Наука про мову, її суспільні функції, загальні особливості, конкретні прояви її структури	однозначне	
ID_02	мовознавство	Наука про мову, її суспільні функції, загальні особливості, конкретні прояви її структури	однозначне	

Figure 1: Lexeme (fragment: unambiguous words linguistics and linguistics)

Table 2 "Synonyms" includes 4 columns: "Word", "Synonym", "Type" and "Characteristic". The column "Type" indicates an absolute or partial synonym, the column "Characteristic" for partial synonyms shows the differences (semantic, stylistic, etc.), for absolute synonyms this cell remains empty. Figure 2 shows a fragment of the table for words *мовознавство* and *лінгвістика*.

Слово	Синонім	Тип	Характеристика
ID_01	ID_02	частковий	обмежена сполучуваність: <i>лінгвістика тексту</i> , але не <i>*мовознавство тексту</i>
ID_02	ID_01	частковий	обмежена сполучуваність: <i>лінгвістика тексту</i> , але не <i>*мовознавство тексту</i>

Figure 2: Synonyms (fragment: unambiguous words *мовознавство* and *лінгвістика*)

Since there are different synonyms for different meanings of a word in a language, each meaning of a polysemous word should be given separately in the database and synonyms should be given for each meaning. Let us show this by the example of the word *бажання* which in the modern Ukrainian literary language, according to the "Dictionary of the Ukrainian language", has three meanings: 1. Aspiration, the desire to accomplish something; will. 2. An opinion expressed by someone about the desirability of doing something; wish. 3. Love attraction, passion [22] (see Figure 3).

#	Слово	Тлумачення	Статус	Характеристика
ID_32	бажання	Прагнення, потяг до здійснення чого-небудь; хотіння	багатозначне	
ID_33	бажання	Висловлювана ким-небудь думка про бажаність здійснення чого-небудь; побажання	багатозначне	
ID_34	бажання	Любовний потяг, пристрасть	багатозначне	
ID_35	хотіння	Прагнення, потяг до здійснення чого-небудь; бажання	багатозначне	
ID_36	побажання	Висловлювана ким-небудь думка про бажаність здійснення чого-небудь; бажання	однозначне	
ID_37	потяг	Пристрасть, любовне бажання	омонім	
ID_38	пристрасть	Любовний потяг, бажання	багатозначне	

Figure 3: Lexeme (fragment: polysemous word *бажання*)

Figure 4 reflected fragment of the table "Synonyms" for polysemous word *бажання*.

Слово	Синонім	Тип	Характеристика
ID_32	ID_35	абсолютний	
ID_33	ID_36	абсолютний	
ID_34	ID_37	абсолютний	
ID_34	ID_38	абсолютний	

Figure 4: Synonyms (fragment: polysemous word *бажання*)

In the created database homonyms are given as separate units. For example, four words *коса* with different values are shown in the table “Lexemes” as shown in Figure 5.

#	Слово	Тлумачення	Статус	Характеристика
ID_24	коса	Довге волосся, заплетене й розплетене, звичайно у жінок	омонім	у поєднанні з прикметниками типу <i>довга, руса, пишна</i>
ID_25	коса	Сільськогосподарське знаряддя для косіння трави, збіжжя тощо, що має вигляд вузького зігнутого леза, прикріпленого до держака	омонім	у поєднанні з прикметниками типу <i>залізна</i>
ID_26	коса	Намивна вузька смуга суходолу	омонім	у поєднанні з прикметниками типу <i>кам'яна, піщана</i>
ID_27	коса	Кровотворний орган хребетних тварин і людини, який бере участь також в обміні речовин і виконує різноманітні захисні функції; міститься в черевній порожнині	омонім	діалектне
ID_28	волосся	Сукупність волосин, що ростуть на шкірі людини (переважно про поріст на голові).	однозначне	збірне
ID_29	волос	Сукупність волосин, що ростуть на шкірі людини	однозначне	збірне
ID_30	мис	Частина суші, яка гострим кутом входить у водний простір (море, озеро, річку і т. ін.).	однозначне	
ID_31	селезінка	Кровотворний орган хребетних тварин і людини, який бере участь також в обміні речовин і виконує різноманітні захисні функції; міститься в черевній порожнині	однозначне	

Figure 5: Lexemes (fragment: homonyms *коса*)

Accordingly, these words have different synonyms (see Figure 6).

Homonym scythe meaning “Agricultural tool for mowing grass, grain, etc., having the shape of a narrow curved blade attached to the braid of a wooden handle” [22] has no synonyms, so the corresponding cell remains blank.

Слово	Синонім	Тип	Характеристика
ID_24	ID_28	частковий	коса – переважно у жінок
ID_24	ID_29	частковий	коса – переважно у жінок
ID_25			
ID_26	ID_30	частковий	коса – намивна, вузька
ID_27	ID_31	частковий	діалектне

Figure 6: Synonyms (fragment: homonyms *коса*)

Table 3 “Integral phrases” contains a list of restrictions on the replacement of synonyms. For example, it is not allowed to replace adjectives in the terminological phrases *лінгвістика тексту* (can not be replaced by **мовознавство тексту*), *державна мова* (but not **урядова мова*, **казенна мова*) and so on.

Table 4 “Descriptive verb-noun constructions” provides the possibility of replacing verbs with verb-noun constructions such as *вести розмову – розмовляти*, *мати розмову – розмовляти*, *мати*

потребу – *потребувати*, *мати змогу* – *могти* and under. This phenomenon is characteristic of many languages of the world, including Ukrainian. Verbal-noun descriptive constructions are qualified by researchers as one of the manifestations of analytical tendencies in language and as one of the components of the sentence paradigm. In linguistics, the term "descriptive predicate" is also used to denote such constructions (for details, see [7, 14, 26]).

It is important for our tasks that descriptive constructions can be absolute and partial synonyms for the corresponding verbs. For example, descriptive predicates are to the verb *бажати* equivalent (partially equivalent) are descriptive predicates *мати бажання*, *виявити бажання*, *відчувати бажання*, *палати бажанням*, *палати від бажання*, *кипіти від бажання*. The last three constructions are partial synonyms: *палати бажанням*, *палати від бажання* have a differential (additional) sema ‘intensity of state’, and *кипіти від бажання* have two additional seven - ‘intensity of state’ and ‘high degree’ (see Figure 7).

#	Описова конструкція	Синонім	Характеристика
DC_01	виявити бажання	бажати	
DC_02	відчувати бажання	бажати	
DC_03	кипіти від бажання	бажати	інтенсивність стану, високій ступінь
DC_04	мати бажання	бажати	
DC_05	палати бажанням	бажати	інтенсивність стану
DC_06	палати від бажання	бажати	інтенсивність стану

Figure 7: Descriptive verb-noun constructions (fragment: synonyms for the verb *бажати*)

The last fifth table is designed to show periphrases that can be an additional resource for synonymous substitutions in the text, for example: *гарант Конституції – Президент*, *імперія зла – СРСР*, *місто Лева – Львів*, *українська Прага – Львів*, *перша столиця – Харків*, *колиця козацтва – Запоріжжя*, *перлина Поділля – Вінниця*, *перлина Карпат – Яремча* and so on. The sources of this table were the “Dictionary of media paraphrases of the XXI century” [28], own file of paraphrases and examples given in scientific papers on this issue [10, 13].

We will show a fragment of this table, covering the paraphrases of the political figure Yulia Tymoshenko, recorded in different periods of her activity in the texts of Ukrainian periodicals: *газова леді*, *газова принцеса*, *Дон Кіхот у панчохах*, *леді Ю*, *українська Жанна Д’Арк*, etc. (see Figure 8). Such figurative names, of course, are incomplete synonyms, as they are always evaluated, contain a negative or positive assessment of the activities or appearance of the person. In this case, the same paraphrase (for example, *газова принцеса*) can express different assessments depending on the communication situation, context, purpose of the author of the message. That's why it's important to be able to manually select a synonym for a computer product user.

#	Перифраз	Денотат	Характеристика
PP_01	газова принцеса	Юлія Тимошенко	піднесене/ зневажливе
PP_02	Дон Кіхот в панчохах	Юлія Тимошенко	зневажливе
PP_03	жінка з косою	Юлія Тимошенко	зневажливе
PP_04	Леді Ю	Юлія Тимошенко	піднесене
PP_05	українська Жанна Д’Арк	Юлія Тимошенко	піднесене

Figure 8: Paraphrases (fragment: paraphrases to denote Yulia Tymoshenko)

3.3. Software implementation of the synonymizer and construction of the visual interface

The five steps formed the basis for the software implementation of the synonymizer using Python 3.x. The urgency of creating a separate software product is dictated by the fact that at the moment we can name a fairly small number of available software applications for professional work with the Ukrainian language. At the same time, the demand for linguistic computer processing of large volumes of Ukrainian texts is constantly growing, and user requests are becoming more professionally oriented.

The prototype of the service “Synonymizer” was implemented locally, to build and test algorithms for solving the stated problem. To do this, the basic capabilities of the Python programming language were used, in particular, the functions of the Tkinter module, libraries for working with the CSV format, and so on.

Before starting work on creating a software product “Synonymizer” it is necessary to normalize these tables following the standards of work with relational databases [2]. This will avoid future data inconsistencies, as well as simplify project scaling in the long run.

The described program “Synonymizer” is only a prototype of the future service, so the proposed product has a minimalist interface.

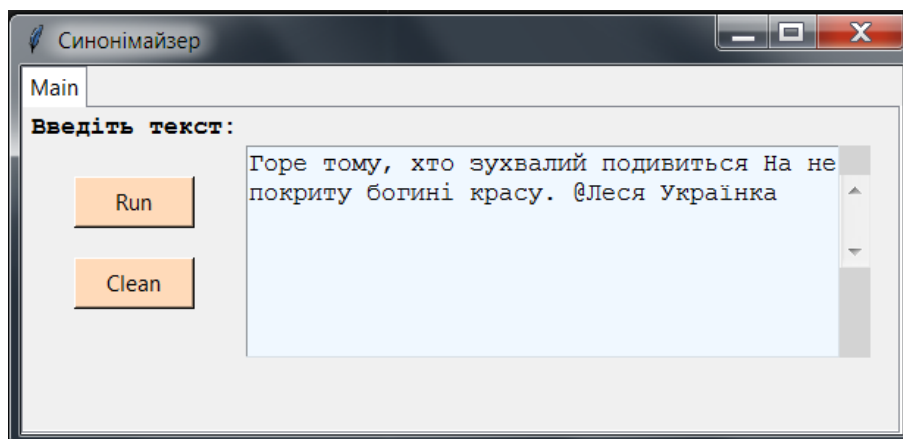


Figure 9: Synonymizer interface

After entering the text, the user clicks the Run button, the Result tab is created and the user is allowed to select a possible synonym for the words that are available in the previously described database of synonyms of the Ukrainian language. An example of the program is shown in Figure 10.

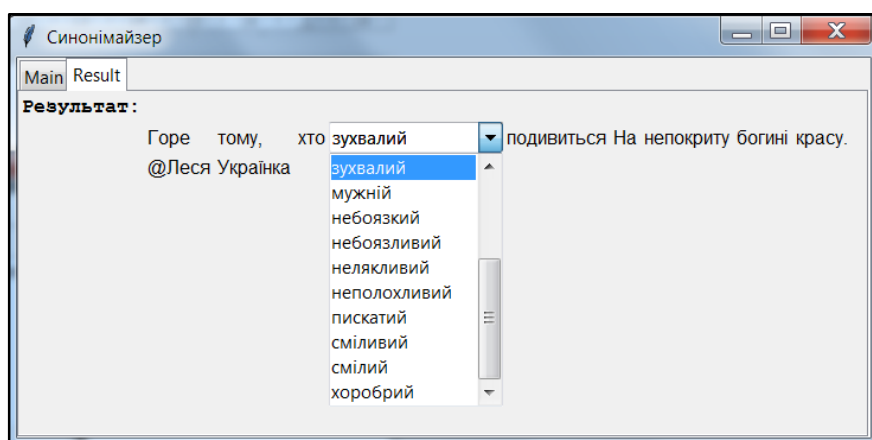


Figure 10: Example of program operation: manual selection of a synonym for one word

The Clean button clears the text box on the Main tab and removes the Result tab.

If we just enter a set of related words - synonyms (e.g., *безбоязний, безстрашний, безтрепетний, відважний, відчайдушний, відчайний, дерзкий, дерзновенний, зухвалий, мужній, небоязкий, небоязливий, нелякливий, неполохливий, пискатий, сміливий, хоробрий*), we get the corresponding result (see Figure 11).

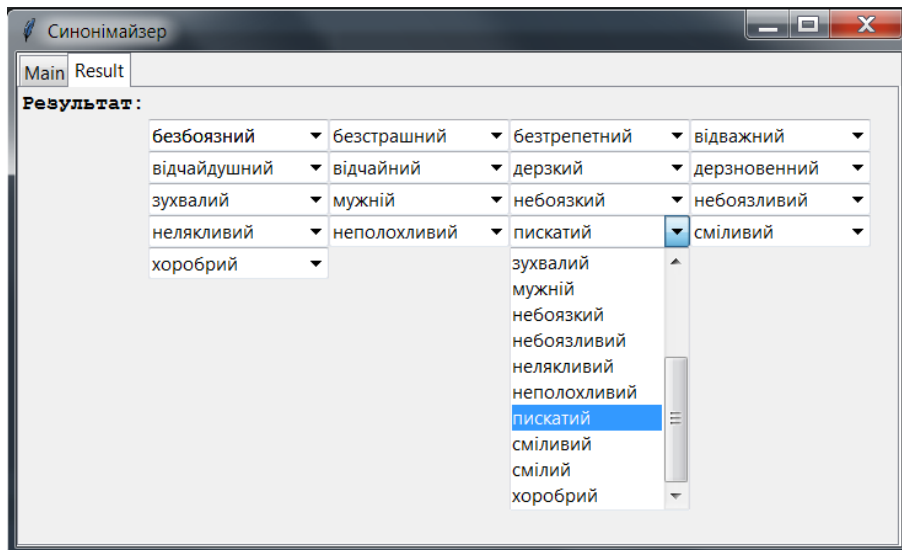


Figure 11: Example of program operation: manual selection of synonyms for several words

The program allows you to track homonyms in the entered text as specific language units. For example, consider the sentences *Кам'яна коса, пісок, красиве небо і дає світло маяк...* (<https://www.nikopoltoday.com/article-364/Nikopol-Akim-bulo-misto-Nikopol-10-rokiv-tomu-fotoekskursia>). In this case, the noun "коса" is combined with the adjective *кам'яна*, so according to the information presented in Figure 6, a synonym for the word *коса* can only be the word *мис*, other options (*волосся, волос, селезінка*) are incorrect.

Figure 12 and Figure 13 show the analysis of the above case: basic (all synonyms available in the database are allowed) and extended (taking into account compatibility).

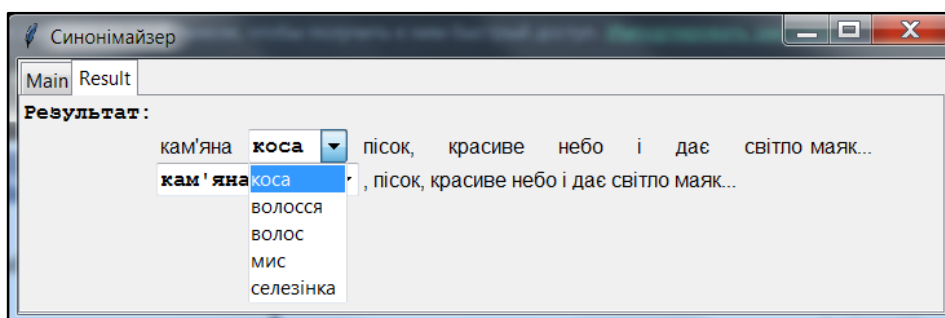


Figure 12: Example of the program: the whole list of synonyms for the word *коса*

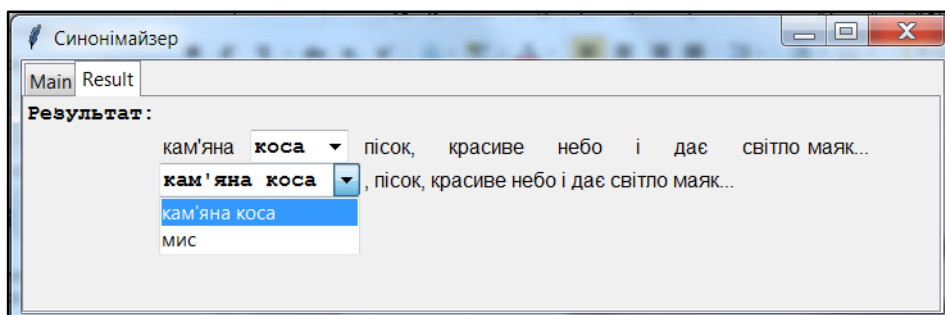


Figure 13: Example of the program: synonyms for the word *коса* taking into account compatibility

However, at the stage of testing the program, there were many examples in which, even taking into account the combination of words, the automatically proposed option was incorrect. In particular, in the sentence *Медитувати – кам'яна коса нашого пляжу ідеально підходить для цього* (<https://www.knyazhahora.com/news/2020/12/10/>) the replacement of the word *коса* with a *мис* (see Figure 14) causes objection because it is impossible to say *мис нашого пляжу*, although such restrictions are not described in dictionaries. Here is another example: in the sentence *Ти висока струнка, в тебе руса коса* (Song “Time flows by the river”), the lexeme *коса* can be replaced by *волосся* (automatically based on compatibility with the word *руса*). However, such a replacement is not possible in the example: *Довга дівоча коса була символом краси, естетики, дівочтва та незайманості* (<https://amazing-ukraine.com/chorni-ochka-iaak-teren-ta-rusa-kosa-do-poiasa-abo-divocha-kosa-v-ukrainskykh-tradytsiiakh/>) because the symbolic load was the girl's braid, not hair at all. Perhaps, in this case, the formal criterion for prohibiting synonymous substitution is the presence of the word *символ* in the sentence. Such cases convinced us of the fundamental possibility of only manual selection of synonyms by the user from the list of proposed and caused a change in the task of building a synonymizer with mixed-mode to a program with the manual mode of word substitution.

At the same time, we consider the implementation of the choice of synonyms on the material of a representative text corpus to involve statistical analysis data to be promising. Besides, synonyms can be suggested for frequent placement in combination with neighbouring words (collocations analysis).

The settings allow you to display additional information in the tables as reference materials for the correct choice of a particular synonym. This requires additional contextual analysis of the textual information entered by the user, but this is one of the immediate prospects of the software application.

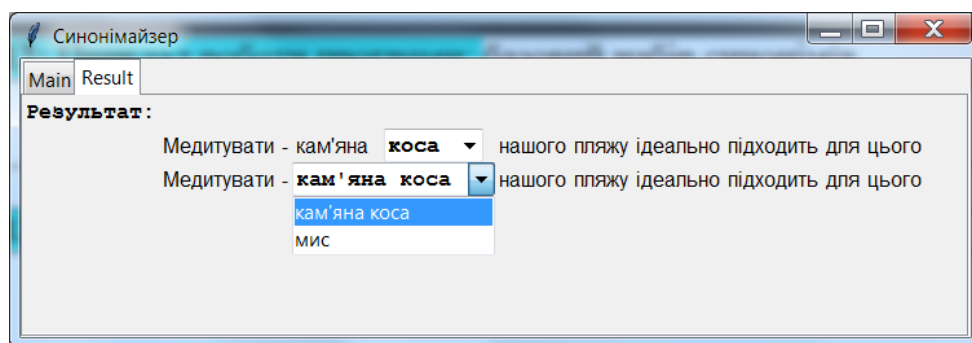


Figure 14: Example of incorrect operation of the program: a synonym for the word *коса*, taking into account the compatibility

After the testing phase, specialized libraries for working with text data, Python libraries for working with SQL databases, web programming technologies, etc. will be used to build the software product. Further development of the software product is planned in two directions. First of all, the formation of a full-fledged database of synonyms of the Ukrainian language will be continued by describing scheme. In parallel, the software interface will be developed, taking into account modern standards of usability ISO / IEC 25010. In the future, it is planned to build a full-fledged web application with additional useful linguistic services.

4. Conclusions and prospects

Thus, we have developed an experimental local version of the synonymizer based on the Ukrainian language. This version of the program provides the possibility for the user to choose synonyms from the list offered in the database and takes into account the database of exceptions (restrictions on synonymous replacement). The question of taking into account the immediate environment of the language unit to choose an appropriate synonym needs further elaboration. The performed testing of automatically obtained word substitutions in texts in the Ukrainian language testified to the incompleteness of the available knowledge about synonyms, the insufficiency of the information provided in the dictionaries of synonyms for the correct transformation of the text fragment and requires the solution of statistical methods (association measures) for the correct choice of synonyms.

Prospects for further research are to involve also synonymous paraphrases at the sentence level. This approach will be based on the notion of the syntactic paradigm of a sentence (see the works of M. Vsevolodova, G. Zolotova, I. Vykhovanets, A. Zahnitko, etc.). The same event of objective reality can be expressed in different sentences, the same or different structure. N. Huyvanyuk calls such sentences “co-referential syntactic units” [14]. First of all, we mean the following cases of transformation of the basic sentence [8; 15; 24]:

1. Sentence transformation (opposition “active - passive state”): *Ціла бригада буде наш дім → Наш дім будується цілою бригадою* (or *Наш дім будовано цілою бригадою*).
2. Sentence conversion - changing the direction of the relationship between the participants of the situation: *Богдан – друг Євгена ↔ Євген – друг Богдана; Син вищий за батька ↔ Батько нижчий за сина; Іван купив автівку в Петра ↔ Петро продав автівку Івану; Зошит лежить на столі під книгою ↔ Книга лежить на столі на зошиті*, etc.
3. Synonymous transformations of different types: *Молекула складається з атомів; Молекули містять атоми; Атоми – складники молекули*, etc.; *Мій батько має нагороду за мужність; У мого батька є нагорода за мужність; Мого батька нагородили за мужність*, etc.

However, the program implementation of the interchange of such cases involves not only the formation of appropriate databases (in particular, active-passive verbs, pairs of words- conversions) but also the formulation of clear grammatical rules of relevant transformations, determining the sequence of their application and possible limitations and exceptions.

5. References

- [1] A. Clark, Ch. Fox, and Sh. Lappin (Eds.), *The Handbook of Computational Linguistics and Natural Language Processing*, Blackwell Publishing, 2010.
- [2] C. J. Date, *SQL and Relational Theory: How to Write Accurate SQL Code*, 3rd edition, O'Reilly Media, 2015.
- [3] Create Synonyms, 2017. URL: <https://docs.microsoft.com/en-us/sql/relational-databases/synonyms/create-synonyms?view=sql-server-ver15>.
- [4] D. Jurafsky, J. H. Martin, *Speech and Language Processing. An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition*, Prentice Hall, Englewood Cliffs, New Jersey, 2000.
- [5] H. Bussmann, *Routledge Dictionary of Language and Linguistics*. Translated and edited by Gregory P. Trauth and Kerstin Kazzazi, Routledge, London, 2006.
- [6] H. M. Hnatiuk, S. I. Holovashchuk, H. N. Horiushyna, N. Ye. Lozova, O. O. Taranenko, V. B. Frydrak, N. Yu. Melnyk, O. I. Nechytailo, L. O. Rodnina, *Slovnyk synonimiv ukrainskoi movy u dvokh tomakh* [Dictionary of synonyms of the Ukrainian language in two volumes], Instytut movoznavstva im. O. O. Potebni; Instytut ukrainskoi movy; NAN Ukrainy, Nauk. dumka, Kyiv, 2001. (Slovnyky Ukrainy).
- [7] H. Sytar, *Opysovi predykaty z modalnym komponentom v ukrainskii movi: struktura y semantyka* [Descriptive predicates with a modal component in the Ukrainian language: structure and semantics]. In: *Linhvistychni studii*, Vyp. 20, Donetsk, pp. 145-151. (2010) (in Ukrainian)
- [8] H. Sytar, O. Mylostna, *Baza danykh yak instrument linhvistychnoho doslidzhennia (na prykladi analizu leksychnykh konversyviv)* [Database as a tool for linguistic research (on the example of lexical conversion analysis)]. In: *Linhvistychni studii*, Vyp. 16, Donetsk, pp. 385-392. (2008) (in Ukrainian)
- [9] I. M. Kobozeva, *Lingvisticheskaya semantika* [Linguistic semantics], Editorial URSS, Moskva, 2000.
- [10] I. V. Onyshchenko, *Osoblyvosti funktsionuvannia peryfrazy yak zasobu vyrazhennia otsinnosti v suchasnykh publitsystychnykh ta informatsiinykh tekstakh* [Features of the functioning of periphrasis as a means of expressing value in modern journalistic and informational texts]. In: *Filolohichni studii*, Vyp. 5, pp. 193-200. (2010) (in Ukrainian)
- [11] K. Malmkjær (Ed.), *The Linguistics Encyclopedia*, London – New York, 2005.
- [12] M. A. Krongauz, *Semantika* [Semantics], RGGU, Moskva, 2001.

- [13] M. B. Bulakh, *Komunikatyvnyi status peryfrazu v media: stylistychna aspektolohiia* [Communicative status of periphrasis in the media: stylistic aspectology]: avtoref. dys. kand. filol. nauk: 10.02.01 – ukrainska mova, Kyiv, 2017.
- [14] M. V. Vsevolodova, *Teoriya funkcional'no-kommunikativnogo sintaksisa. Fragment prikladnoj (pedagogicheskoy) modeli yazyka* [Theory of functional-communicative syntax: a fragment of the applied (pedagogical) language model], URSS, Moskva, 2017.
- [15] N. V. Huivaniuk, *Formalno-semantychni spivvidnoshennia v systemi syntaksychnykh odyntys* [Formal-semantic relations of syntactic units in the system of syntactic units], Ruta, Chernivtsi, 1999.
- [16] Online Sinonim, 2013. URL: <https://online-sinonim.ru/>.
- [17] O. S. Vusyk, *Slovyk sinonimiv ukrainskoi movy: ponad 2500 sinonimichnykh hnizd* [Dictionary of synonyms of the Ukrainian language: more than 2500 synonymous nests.], Navchalna knyha – Bohdan, Ternopil, 2013.
- [18] Paraphrase Online, 2021. URL: <https://www.paraphrase-online.com/>.
- [19] Paraphrasing Tool, 2021. URL: <https://paraphrasing-tool.com/>.
- [20] S. Karavanskyi, *Praktychnyi slovyk sinonimiv ukrainskoi movy* [Practical Dictionary of Synonyms in the Ukrainian Language]. 5-te vyd., opratsovane i dopovn., BaK, Lviv, 2014.
- [21] SeoGenerator, 2009. URL: <http://www.seogenerator.ru/>.
- [22] *Slovyk ukrainskoi movy u 20-ty tomakh* [Dictionary of the Ukrainian language in 20 volumes]. URL: <https://services.ulif.org.ua/expl/Entry/index?wordid=1&page=0>
- [23] Synonymizer, 2006. URL: <http://synonymizer.com.ar/index.php#top>.
- [24] *Ukrainska mova: Entsyklopediia* [Ukrainian language: Encyclopedia]. 2-e vyd., vypr. i dop., Vyd-vo «Ukrainska entsyklopediia» im. M. P. Bazhana, Kyiv, 2004.
- [25] USyn, 2009. URL: <http://usyn.ru/online.php>.
- [26] V. A. Kuz'menkova, *Tipologiya opisatel'nyh predikatov i ih analogov v sovremennom ruskom yazyke* [Typology of descriptive predicates and their analogues in modern Russian]: avtoref. diss. ... kand. filol. nauk : 10.02.01 – russkij yazyk. Moskva, 2000.
- [27] V. V. Levickij, *Semasiologiya* [Semasiology], Nova knyga, Vinnica, 2006.
- [28] Ya. V. Kozachok, V. M. Vasylchenko, I. A. Kostyuk ta in., *Slovyk mediinykh peryfraziv XXI stolittia* [Dictionary of media paraphrases of the XXI century], NAU, Kyiv, 2014.
- [29] Yu. D. Apresyan, *Izbrannyye Trudy. Tom I. Leksicheskaya semantika* [Selected works. Vol. I. Lexical semantics]: 2-e i zd., ispr. i dop. Shkola «Yazyki russkoy kul'tury», Izdatel'skaya firma «Vostochnaya literatura» RAN, Moskva, 1995. VIII s.
- [30] Yu. D. Apresyan, V. Yu. Apresyan, E. E. Babaeva, O. YU. Boguslavskaya, I. V. Galaktionova, M. Ya. Glovinskaya, S. A. Grigor'eva, B. L. Iomdin, T. V. Krylova, I. B. Levontina, A. V. Ptencova, A. V. Sannikov, E. V. Uryson, *Novyj ob'yasnitel'nyj slovar' sinonimov russkogo yazyka* [New explanatory dictionary of synonyms of the Russian language]. Vtoroe izdanie, ispravlennoe i dopolnennoe, *Yazyki slavyanskoj kul'tury: Venskij slavisticheskij al'manah*, Moskva; Vena, 2004. (Studia philologica)