A Comparative Analysis for English and Ukrainian Texts Processing Based on Semantics and Syntax Approach

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Abstract

The article deals with the application of generating grammars in linguistic modelling. Analysis of sentence syntax modelling is used to automate studying and synthesising natural language texts. The complex research of automatic processing of English and Ukrainian texts considering the semantics and syntax of natural languages is conducted. A comparative linguistic approach to the syntax and semantics of English and Ukrainian languages synthesises the corpora of natural language texts. The automatic operation of relevant text data is carried out. Comparative analysis of these languages facilitates the development of the linguistic algorithm for converting natural language texts of Germanic and Slavic type.

1. Introduction

Each language is unique in its structure and characteristics of the linguistic unit's construction for delivering meaningful texts. For automatic processing of coherent data texts, developing the algorithms for analysis and synthesis of natural language texts [1]. For example, it is for automatic translation, synthesis of replies in robotics, intuitive dialogue in machine-human mode, and automated processing of different languages' information resources starting with filtering/searching relevant data to form event proposals for the media. The difficulties begin with the developer's personality as he/she is used to perceiving the realis within the scope of the natural language from the early years without being conscious of the depth of another language group than his/her native [2-3]. Why is it difficult for foreigners to learn Ukrainian if their mother tongue is of another language group, not Slavic? What are the characteristics of automatic translation or recognized image descriptions regarding the syntax (the problem is almost perfectly solved in this field) and semantics of the texts? Let us consider an example.

In front of us, there is a table with a glass and a fork on it. What actions do they perform? The glass stands, and the fork lies. If you stick the fork into the tabletop, it will stand either. Can we say that the vertical objects tend to stand and horizontal – to lie? Let us put a plate and a frying pan on the table. They seem to be horizontal, but it is said in the Ukrainian language that they "stand" on the table [3]. If a plate is put into the frying pan, a native speaker would say it "lies" in the pan. Shall we say that items ready for use can "stand"? No, we cannot, as the fork is prepared when it is on the table. Now a cat climbs on the table. It can stand, sit and lie down. If standing and lying fit into the logic of "vertical-horizontal", then to sit is a new position. Now a bird flies to the table. It would be described as "a bird sits on the table" in the Ukrainian language [4]. It sits on her feet.

Nevertheless, it stands though this verb is not used to describe the position of that. However, if you make a stuffed animal out of this bird, it will "stand" on the table [2]. It seems that the seat is an attribute

of a living thing. On the other hand, the boot also "sits" on foot, and it is not an actual item and does not have the part of the body on which the cat can sit. It is not clear what principle and what logic is used to describe the action of sitting, lying, and standing. That is why the foreigners consider our language quite complex, and in-jokes compare it with Chinese. For a native speaker who is used to think according to the rules of his mother tongue, such nuances of usage are natural. Still, they are pretty confusing for a foreigner, especially for another language group [3].

Considering the structures of the synthetic of English and Ukrainian sentences, we can find that English, unlike Ukrainian, has a direct word order in a sentence [5]. It is arranged according to the following pattern: *Subject + Predicate + Object*. The other parts of the sentence are usually placed in front of the subject or after the object. Let us give you an example of the number of ways how the sentence *Ditiam* (*children*) *podobaietsia* (*like*) *morozyvo* (*an icecream*) can be expressed in the Ukrainian language [3]:

1. *Ditiam podobaietsia morozyvo.* (*Дітям подобається морозиво.*)
2. *Ditiam morozyvo podobaietsia.* (*Дітям морозиво подобається.*)
3. *Morozyvo podobaietsia ditiam.* (*Морозиво подобається дітям.*)
4. *Morozyvo ditiam podobaietsia.* (*Морозиво дітям подобається.*)
5. *Podobaietsia ditiam morozyvo.* (*Подобається дітям морозиво.*)
6. *Podobaietsia morozyvo ditiam.* (*Подобається морозиво дітям*)

The same sentence has the structure in English: *Subject + Predicate + Object* (*Children like an ice cream*). Changing standard word order is called "inversion", and it is also typical for the English language, especially with the aim of emphasis. Still, it is not as common as in Ukrainian [6-8]. English is an analytical language, while Ukrainian is a synthetic language [9-12]. In analytical languages, the relationship between words in a sentence primarily depends on word order.

In contrast, synthetic languages show case by inflecting words (i.e., changing the phrase form in pre-established patterns). The words *children*, *like*, *ice cream* are not declined in cases and therefore formally cannot indicate who likes what (purpose of action, i.e., to determine where the subject and where the object of action): *дітям морозиво* (*an icecream for the children*) or *морозиву діти* (*children for the icecream*). The last pattern does not make sense, but if to substitute *ice cream* with a name of the living creature, we will receive the different meaning of the sentences: *Children like animals* (*Дітям подобаються тварини*) and *Animals like children* (*Тваринам подобаються діти*) [3].

2. Related works

It is crucial to define a linguistic unit first for the development of any linguistic algorithm. For this purpose, the analysis, which consists of two stages, is carried out [1-3]: 1) the reason for the future algorithm and 2) the group of languages for which the algorithm is set. According to the purpose of the future algorithm, the corresponding areas of research and analysis are chosen: grapheme, morphological, syntactic, semantic, lexical, etc. The latter one determines a choice of lexical units as a part of natural language. Any language consists of sounds (in oral speech) and letters (in writing). In its turn, sounds and letters make syllables, and syllables constitute the parts of words. Sentences consist of words, and texts comprise sentences [1-7].

Areas of research and analysis of natural language	Linguistic Analysis				
	Structural			Lexical	
	Grapheme	Morpheme	Morphological	Syntactic	Semantic
Oral speech (phonetics)	sound	syllable	word	sentence	text
Orthography (spelling)	letter				

Figure 1: The general structure of natural language

Each of these components has specific rules and patterns of functionality. Phonetics studies pronunciation of sounds, words, the intonation of a sentence; orthography includes norms of spelling, capitalization, word breaks, and punctuation; lexicography deals with the compilation of dictionaries; morphology studies how words are formed and their relationship to other words in the same language; and the rules of arrangement of words into sentences are studied by syntax [8-12].

Unfortunately, all languages (unfortunately, today we do not know the exact number of languages spoken by the Earth's population: it comprises some about a few thousand) are combined into groups [3]. English belongs to the same group of Danish, German, Norwegian, Swedish, and other languages. They form a group of Germanic languages, which together with languages of Europe and Asia, for example, Slavic (Belarusian, Bulgarian, Polish, Ukrainian, Russian, Czech, etc.), Romance (Spanish, Italian, Romanian, French, etc.) comprise one large family of languages – Indo-European one [13-25].

In the process of historical development, the English language has undergone significant changes [3]. In the early ages of its development, it was an inflectional (synthetic) language, i.e. nouns had gender (Masculine, Feminine, Neuter), varied in cases. However, as in the Ukrainian language, there were not seven cases, but only four – Nominal, Genitive, Dative, Accusative, which are still preserved in the German language). Adjectives agreed with nouns in case, number and gender (as in the Ukrainian language), and the sentence word order was loose. Modern English is very different. Table 1 is presented an English and Ukrainian languages comparative analysis [26-37].

Table 1
The English and Ukrainian morphology comparative analysis

Part of speech	English	Ukrainian
Article	English has two articles types: indefinite and definite.	non-applicable
Noun	Does not have a grammatical gender	It has grammatical gender.
	Nouns are divided into nouns that denote people and nouns that represent objects and phenomena.	Based on grammatical gender, nouns are divided into Neuter, Feminine and Masculine gender.
	Modern English has three cases: Nominative (also called Subjective), Accusative (Objective) and Genitive (possessive).	There are seven cases.
	Relationships and connections are expressed via prepositions.	Relationships and connections are expressed via cases.
Adjective	Adjectives do not agree and change by gender, number, and case.	Adjectives agree with a noun in case, number and gender.
Numeral	Do not agree in case gender	It agrees in case and gender.
Pronoun	Pronouns are divided into seven categories.	Pronouns are divided into nine categories.
	The personal pronoun *you* have the same form in the plural, addressing a group of people, and the singular, addressing one person.	There are two forms of the personal pronoun of the second person: in the singular *ty* (*mu, you*), in the plural *vy* (*ви, you*).
	Personal pronouns: *she* means living beings of the female sex; *he* replaces nouns that denote living beings of the male sex; *it* replaces nouns that indicate inanimate objects and animals of the masculine, feminine, neuter gender singular form.	Personal pronouns: *vin* (*він, he*) denotes all masculine nouns; *vona* (*вона, she*) denotes all feminine nouns; *vono* (*воно, it*) marks all neuter gender nouns.
Verb	The form of the verb depends on the action it expresses. Is it the one, which occurs in general, always, constantly, often? Does it happen at the time of speech or before some other action in the past, etc.?	It is used to show that the action is completed/not completed. It does not express the meaning of the action as the English verb does.
	It is widely used with various adverbs that change their lexical meaning.	Non-applicable
Infinitive	It has its basic or root form similarly as it is in the Ukrainian language. There are, however, four other forms of the infinitive, which depend on the verb tense.	It has only a basic form.
Participle	English verbs have two participles: the present participle and the past participle. Participles	It has only one form.

	are also used in the function of adverbial modifiers.	
Diiepryslivnyk (verb+adverb)	Non-applicable in "pure" form	It has two forms.
Gerund	It has six forms	Non-applicable
Non-finite verbs	Non-applicable	They are available in the language, e.g., vechoriie (it is getting dark).
Adverb, preposition, conjunction and exclamation	There are no significant differences.	
Sentence	Direct word order in a sentence: Subject + Predicate + secondary parts of the sentence	Word order in a sentence is loose.

There are 26 letters in English (Table 2) [1-7].

Table 2

Comparative analysis of the phonetic and orthographic features of English and Ukrainian languages

Linguistic unit	English	Ukrainian
Letters	26	32
Consonants	20	22
Vowels	6	10
Sounds	44	38
Consonant sounds	24	32
	There is no division; almost all of them are pronounced firmly before any vowel.	They are divided into hard and soft; there is a softening of consonants before some vowels (sound [c] ([s]) in words *sino* (*сіно*, *hay*) and *siryi* (*сірий*, *gray*)
Vowel sounds	12	6
	They can be long and short. If to replace one sound with another one, it leads to a change of the word meaning.	Non-applicable
Diphthongs (sounds)	8	Non-applicable
	Some English vowels consist of two elements, which are pronounced within the same syllable (diphthongs).	
Voiced consonants	They are always voiced at the end of a word and before deaf consonants; the word's meaning often changes if they are unvoiced.	Voiced consonants change into deaf sounds at the end of the word: *viz* (*віз*, *cart*) [віс] ([vis]), *Bog* (*Бог*, *God*) [бох] ([boh]), *dub* (*дуб*, *oak*) [дуп] ([dup]).

These letters separately or in combination form is 24 consonant sounds and 20 vowels and diphthongs. Thus, there are fewer letters in English but more consonant and vowel sounds; diphthongs are not available in the Ukrainian language. Therefore, the pronunciation and reading of English letters and sounds unavailable in the Ukrainian language cause some difficulties in mastering English phonetics [1-7].

It is well known that English pronunciation does not follow the rules the words are spelt. There is even a joke on that phenomenon "Write Manchester, read Liverpool." The differences between spelling and pronunciation of words are very significant. Since the sound system of the English language has undergone great changes for a long time, the spelling has not changed. As it is already mentioned, 26 letters of the English alphabet can make 44 sounds. The sound system of the Ukrainian language has 38 sounds: 6 vowels and 32 consonants. Thus, the same letter can have several sound meanings, i.e. to transmit several different sounds. As an example, let us consider the English words *night* and *thought* [3]. The first word has five letters, pronounced as [nait], not [night]. The second word has seven letters, and it is pronounced as [θɔ:t], not [thought]. Some words are read and spelt the same, for example, *ten*

[ten], *bin* [bin], etc. Each sound of the English language has a corresponding symbol in the phonetic transcription. English sounds significantly differ from the sounds of the Ukrainian language. Some sounds in English do not have an equivalent one in Ukrainian. There are also differences in the intonation of the English sentence comparing to the Ukrainian one.

Some features are worth discussing to consider vocabulary, i.e. the transfer of words and phrases of the English language into Ukrainian. It would be most convenient for language study or translation if there were a single English equivalent (vase – vase) for each Ukrainian word or phrase and vice versa. However, language is an alive system that constantly develops (often independently of other languages), and that is the reason to classify its words and phrases into three groups [3]:

1. Words and phrases having direct equivalents: *snow* [snəʊ] – *snig* [snih], to *do exersises* [du ˈeksəsaızız] – *vykonuvaty vpravy* [vykonuvaty vpravy] (ukr. *виконувати вправи*).
2. Words and phrases that have
    a. A corresponding meaning only in a certain context (polycemy): *floor* [flɔ:(r)] – *the surface of a room that you walk on* or *level of building* (Ukr. *підлога* or *поверх*);
    b. The meaning of components is different from the meaning of the whole word combination: *hour hand* [ˈaʊə hænd] – *the small hand on a clock or watch that points to the hour* (Ukr. *годинкова стрілка*): *hour* – *hodyna* (*година*), *hand* – *ruka* (*рука*).
3. Words and phrases that do not exist in another language and are translated only with the help of a descriptive method: *assassination* [əˌsæsɪˈneɪʃn] – *pidstupne vbyvstvo* [ˌpidstupne ˈvbyvstvo] (*підступне* (*зрадницьке*) *вбивство*); *doba* (*доба*) [doba] – *day and night* [deɪ ənd naɪt], or *24 hours* [ˈtwenti fɔ:(r) ˈaʊə(r)z]; *blakytnyi* (*блакитний*) [blakytnyi] – *blue* [blu:], *synii* (*синій*) [syn`ii], – *blue* [blu:].

3. Material and methods

The main differences in the phonetic and grammatical structure of modern English and Ukrainian languages are presented in Table 3 [3, 38-49].

The noun in English and Ukrainian denotes objects, persons, phenomena, concepts, and substances: *a table*, *a man*, *snow*, *friendship*, *water* [3]. As well as in the Ukrainian language, the noun performs a function of a subject (*a girl plays*), part of a predicate (*he is a doctor*), an attribute (*English teacher*), adverbial modifier (*children go to school*). Nouns are divided into proper and common nouns in both languages. Nouns are divided into *countable*: *a car – many cars*, *a girl – two girls*, *a book – books*, and *uncountable*: *love*, *air*, *freedom*, *peace*. Countable nouns have plural and singular forms. The plural form is made by adding *-s* to the corresponding noun. We add an ending *-es* if the noun ends in *-ch*, *-x*, *-sh*, *-ss*, *-o*. There are some irregular forms: *a piano – two pianos*, *a photo – photos*, *a radio – radios*. The *f* is often changed to *-ve* before adding the *-s* to form the plural form if the noun ends with *-fe* or *-f*, e.g., *a knife – knives*, *a wife – wives*, *a wolf – wolves*, *a life – lives*. Exceptions are *a roof – roofs*, *a chief – chiefs*. If a singular noun ends in *-y* and the letter before the *-y* is a consonant, then the ending is changed into *-ies* to make the noun plural, e.g., *a story – stories*, *a city – cities*, *a factory – factories*. If the singular noun ends in *-y* and the letter before is a vowel, only *-s* is added to make it plural: *a key – keys*, *a day – days*, *a play – play*. Irregular nouns follow no specific rules and change a root vowel: *a foot – feet*, *a mouse – mice*, *a tooth – teeth*, *a woman – women*, *a man – men*. Some nouns preserve an old English ending in the plural: *a child – children*, *an ox – oxen*, *a chick – chicken*. Some English nouns are only used in singular: *advice*, *information*, *news*, *knowledge*, *furniture*, *money*, *weather* and others. Other nouns are used only in the plural: *goods*, *trousers*, *scissors*, *clothes*, and others. Some collective nouns are used only in the singular form (preserving the plural meaning): *police*, *cattle*, *people* and others. If the word "*people*" means nation, it has singular and plural forms. Family names in the plural form are used with the definite article and denote each family member, for example, the *Browns*, (the family of Brown), the *Kovalenkos* (the family of Kovalenko).

Possessive case. Nouns in English have only two issues: nominative (*Victor*, *father*) and possessive (*Victor's school*, *father's work*) [3]. The possessive case shows ownership. A noun can change from a simple place, person, or thing to a place, person, or thing that owns something with the addition of *'s* (or sometimes just the apostrophe). In the Ukrainian language, it corresponds to the genitive case that also expresses possession. The possessive case of nouns is formed by adding an apostrophe and the

letter *s* (-*'s*) to the singular noun form in the general case and an apostrophe (-') to the plural noun form. And sometimes to the singular nouns ending in -*s* or -*x* (except for the noun *child – children*, *child's – children's*): a *girl+'s = a girl's* hat (a hat which a girl owns); *Victor+'s=Victor's book* (a book which Victor has); *an actress +'s = an actress's role* (a role performed by an actress); *girls+' = girls' hats* (hats which girls have). The apostrophe or an apostrophe and an *s* are added: *James's car or James' car* (a car that James has), if a proper name ends with an –*s*. The possessive case is used when a possessor is a person or an animal (*a boy's name*, *a cat's tail*), name of the organization, country, city, time (*a company's success*, *Ukraine's population*, *London's theatres*, *Sunday's newspaper*). The pronunciation of ending -*'s* follows the same rules as for the plural forms of nouns [3].

Table 3
Phonetic and grammatical features of English and Ukrainian languages [3, 38-49]

Linguistic unit	Meaning	Language	
		English	Ukrainian
Active voice	A person or thing acts. See *Passive voice*	Direct order of words (A boy *broke* a cup).	The word order is not direct: *Khlopchyk rozbyv chashku* or *Chashku rozbyv khlopchyk* (*A boy broke a cup* or *A cup was broken by a boy*).
Alternative question	A question, which suggests a choice.	A direct order of words (Does he speak English *or* Spanish?).	Word order is loose: *Vin hovoryt anhliiskoiu chy ispanskoiu?* or *Hovoryt vin anhliiskoiu chy ispanskoiu?*(Does he speak English or Spanish?).
The comparative degree of adjectives	Form of an adjective/adverb, which is used to compare two or more things.	There are three degrees of comparison: the Positive degree, the Comparative degree, and the Superlative degree (*smaller than*, *most expensive*).	There are two degrees of comparison: the comparative degree (smachnishyi – tastier), and the superlative degree (naismachnishyi – tastiest).
Relative clause	A sentence, which is introduced by a relative pronoun.	A direct order of words (This is the book, *which I bought yesterday*).	The word order is loose (*Tse knyha, yaku ya kupyv vchora* or *Tse knyha, yaku vchora ya kupyv*).
Relative pronouns	Pronouns, which are used to connect the main and subordinate clauses.	Relative pronouns are *who*, *whom*, *that*, *which*, *whose*.	They are *what, who, how much, what, whose, which*.
Participle	A form of a verb, often ending in "-ed" or "-ing" and used with auxiliary verbs to make verb tenses or to form adjectives (a sleeping boy, a written text).	A participle is a non-finite form of an English verb with the features of a verb, an adverb, and an adjective. In the Ukrainian language, the English participle corresponds to participle forms and verb + adverb.	Active participle indicates an ongoing or completed action or state in the active voice. A noun modified by the participle is taken to represent the agent of the action denoted by the verb: *palaiuche nebo* (burning sky). Passive participle indicates an ongoing or completed action or state in the passive voice. A noun modified by the participle represents the patient of the action denoted by the

			verb: *posiiane zhyto* (sown rye).
Participle I (Present Participle)	It has two forms: Present Participle Simple, which corresponds to Ukrainian participle of the present time, and Past Participle Perfect, which corresponds both to Ukrainian participle of the past and a verb, which shows an incomplete action.	The Present Participle Active is formed with the suffix *-ing* and is used to create the progressive tenses (Reading the book, he makes notes). It is translated into Ukrainian as the participle of the active voice.	Present Participle Active is formed from the present tense of transitive and intransitive verbs with the suffixes *-uch* (*yi*), *-yuch* (*yi*) for verbs of the 1st conjugation and *-ach* (*yi*), *-yach* (*yi*) for verbs of the 2nd conjugation: *reve – revychyi* (to roar – roaring), *pratsuye – pratsuyuchiy* (to work – working).
Participle II (Past Participle)	It corresponds to the Past Participle in Ukrainian. The passive voice of the participle in the Ukrainian language is formed of the infinitive of transitive verbs, which denote complete/incomplete action by adding suffixes *-t (yi), -n (yi), -en (yi), -ien (yi):* myty (to wash) – mytyi (washed), napysaty (to write) – napysanyi (written).	Past Participle expresses completed action, which is traditionally one of the verb's principal parts, and that is usually used in English to form perfect tenses in the active voice and of all tenses in the passive voice break-broke-*broken* (a *broken* cup). It is translated into Ukrainian as the past participle.	Past Participle Active is formed from the infinitive of intransitive verbs only with the suffix -l (iy): *zamerznuty – zamerzlyi* (to freeze – frozen), *pobility – pobililyi* (to whiten – whitened).
Verb	A word or phrase shows an action or state (Children *play* in the yard. He *loves* his children.). English verbs, as well as Ukrainian ones, denote feelings (*to hear, to like*), an process (*to sleep, to rest*), action (*to go, to build*), mental activity (*to think, to realize*). Some English verbs consist of two words: *to whitewash, to browbeat, to machine-gun*, others coincide in the form of a noun (to record – a record) or an adjective (less common).	The verbs are divided into modal verbs, verbs denoting senses of perception, phrasal verbs and irregular verbs. Verbs are categorized as **simple, derivative,** and **compound**. Simple verbs consist of one non-derivative base: *to try, to go, to speak, to run,* and others. **Derivative** verbs have suffixes or prefixes: *to organize, rewrite, to discover, to mispronounce*. A **compound** verb or complex predicate is a multi-word compound that functions as a single verb. They are formed of two parts – a verb and a particle or preposition, which are written separately and can be separated by other words: *to stand	The verb has five forms in the Ukrainian language. These forms are recognized by their characteristic endings: 1) indefinite form (infinitive); 2) personal forms: (vin) *pysh-***e**, *pysa-***v**-**Ø**, *napysh-***e**, *bude + pysa-***ty**, *pysaty-***me**, *pysa-***v**-**Ø** + *by*, *khai + pysh-***e**; 3) participle: **pozhovti**-*l-***yi**, *posyvi-***l-yi**; *pysa-***n-yi**, *pidpysa-***n-yi**; *zaliubl-***en-yi**; *bach-***en-yi**; *vymy-***t-yi**, *kolo-***t-yi**. Active Participle is uncommon in the Ukrainian language *pyshuchyi* (writing). This function is performed by descriptive constructions: *shcho/yakyi pyshe* (that /which writes); 4) impersonal forms ending in *-no/-to*: *napysa-***no**, *zroble-***no**, *prozhy-***to**, *vypy-***to**; 5) diiepryslivnyk (verb + adverb): *pysh-***uchy**, *liubl-***yachy**, *pidpysa-***vshy**, *poliuby-***vshy**.

		up, to sit down, to go away, to put on, and others. Compound verbs are very common in English. The endings are added to the base: *I am writing down your address. He always wakes up at 7 o'clock.*	
Indicative Mood	The indicative mood is used for positive beliefs and factual statements. Indicative-mood verbs function in many tenses and forms.	Indicative mood shows that the action is considered a fact in the future, past or present tense.	The meaning of the past and present tense is accurate, and the purpose of the future is hypothetical to express some desired action.
Object	A noun phrase or a noun is affected by the verb action, or that follows a preposition. Additionally, almost any group of words that functions as a noun can be an object, such as noun clauses, gerunds, noun phrases, and infinitives.	An object is a noun (or pronoun) that is governed by a preposition or a verb. There are three kinds of thing: direct object (I know *him*), indirect object (Give her *the prize*), an object of a preposition (Sit *with them*). The object can be expressed by gerund, pronoun, a noun, infinitive, or the whole subordinate clause (They ask *me to help.* I can see *a bus.*).	The object has the same parts of speech as the subject.
Yes/No questions	A general question the answer to which is *Yes* or *No*.	Direct word order in a sentence.	The word order is not direct.
Pronouns	A word is used instead of a noun phrase or a noun (A boy reads books – *He* reads books). Pronouns are divided into several categories according to their linguistic meaning and morphological features.	English pronouns are divided into several categories: interrogative, demonstrative, possessive, reciprocal, reflexive, indefinite, personal, and relative.	Ukrainian pronouns have nine categories: personal, reflexive, interrogative, relative, possessive, demonstrative, definite, indefinite, and negative.
Negative sentence	A sentence with a particle *not* (He *does not* speak English. We *do not* like classical music).	Direct word order in a sentence.	The word order is loose.
Reflexive pronouns	A personal pronoun compounded with -*self* to show that the agent's action affects the agent (*She* dressed *herself*).	Reflexive pronouns are words like *myself, yourself, himself, herself, itself, ourselves, yourselves* and *themselves*.	*The reflexive pronoun is sebe (self).*
Noun	A name (*Robert*), person or thing (*a teacher*, *a table*), action (*a conversation*).	It is not declined according to the gender of the noun.	It is declined according to the gender of the noun.
Attributuve noun	A noun that modifies another noun and functions as an	It is applicable in the language.	Not specified.

	adjective: *a stone* bridge (a bridge made of stone).		
Infinitive	A base verb form	An infinitive is formed from a verb but does not act as a verb. It is usually used with a particle *to* (He likes *to write* letters) or without it (I made her *read*).	We add ending -ty to the stem of the verb: *pysa*-**ty** (to write), *hovory*-**ty** (to speak), *lita*-**ty** (to fly), *hrymi*-**ty** (to thunder), *merznu*-**ty** (to frost), *dyvuva*-**ty** (to wonder).
Adverbs of number	Refers to an adverb that signifies how many times an action is performed or in what numerical order it is performed.	It is a word indicating the quantity of something: *many, much, some, any*.	It answers the questions: *How? Where? How much?*
Short answers	Positive short answers are formed with *yes + subject + auxiliary verb*, and negative answers with *no + subject + negated auxiliary verb*. (Who came? – *Mike did*).	Direct word order in a sentence.	The word order is loose.
Plural forms	More than one (*girls, men, children, rooms*). See *Singular form*s	It is formed by adding *-s* to the nouns except the forms of irregular plural nouns.	Different inflexions are added depending on the noun gender
Modality	Modality is about a speaker's or a writer's attitude towards the world. A writer or speaker can express necessity, obligation, willingness, possibility, certainty, and ability by using expressions and modal words.	Modal verbs are *needn't, need, ought to, must, should, shall, would, will, might, may, could, can, used to*.	Grammatically, modality is expressed by combining a verb (or other predicates) with modal particles, adverbs, verbs, phrases and sentences. Different modality is shown in the following examples: *pidy-no* (Will you go?), *pidy* (Go!), *ty b pishov* (Would you go?), *nekhai by ty pishov* (Let you go), *bodai by ty pishov* (Make you go).
Superlative degree of adjectives	Superlative adjectives describe one person or thing as having more quality than all other people or something in a group.	*the largest, the most important*	The simple form of the excellent degree takes the form of the comparative degree + prefix *nai-*. Prefixes *yak-* and *shcho-* are used for expressing emphesis. Degrees of comparison for adverbs have a compound form. They make comparative degree by adding the words *bilsh* (more), *mensh* (less), and the excellent degree – the words *naibilsh* (most of all), or *naimensh* (least of all).
Imperative clauses	Imperative clauses most commonly function as instructions, commands, or orders.	It has a direct word order (Open the book! Do not smoke!).	The word order is loose.

Uncountable nouns	Nouns, which do not have a plural form: *air, snow, milk, freedom.*	They function as exceptions because of having only singular or plural form.	They function as exceptions because of having only singular or plural form.
Irregular verbs	Irregular verbs have different forms for the past simple and the *-ed* form. See *Regular verbs.*	An irregular verb does not form its simple past tense or its past participle by adding *–d* or *-ed* to the base form: *to be – was/were – been.*	It is not specified.
Singular form	A noun denotes one thing/person (*a girl*, *a man*, *a child*, *a room*).	It is used only with an article.	It does not have an article.
Exclamations	Exclamations are used to express surprise, shock, or a strong emotion about something (What a nice day!)	Have a direct word order.	The word order is loose.
Person	A grammatical category of a pronoun.	Singular first-person pronouns include *I, me;* second person – *you;* third person – *he, she, it, one.*	First-person pronouns – *ya* (I), *mene* (me); second person – *ty* (you); third person – *vin* (he), *vona* (she), *vono* (it), *vony* (they). Not specified.
Passive voice	In the passive, the person or thing that the action is done to becomes the topic or theme.	We make the passive by putting the verb *into whatever tense we need and* adding the past participle: *to be*+ Past Participle (A cup *was broken*).	
Questions	A question is anything we write or say which requires a response. There are four types of questions in English: choice questions, particular questions using wh-words, general or yes/no questions, and disjunctive or tag/tail questions.	A direct word order.	The word order is loose.
Subject question	Subject questions are used to ask *who* or *which* person or thing does something (Who rode the train to work?). Subject questions follow the same subject-verb structure as statements.	It has a direct word order (Who came late? – Jack did.)	The word order is loose.
Subject	It is the word or phrase, which controls the verb in the clause, that is to say with which the verb agrees.	*We* are happy. *A car* has two doors.	*My* shchaslyvi (Ми щасливі). *Mashyna* maie dvoie dvertsiat (Машина має двоє дверцят).
Verbs denoting senses of perception	They are the verbs: *feel, hear, look, smell, taste, sound.*	They have some syntactical feateres of usage.	No syntactical feateres of usage.
Regular verbs	Most verbs in English are regular. Regular verbs add *-ing* to the base form to make the *-ing* form, and *-ed* to the base	In English, we add *-ed* or *-d* to the base form of the verb to create the	Only regular verbs.

	form to make the past simple and the -ed form. See *Irregular verbs.*	past forms: *play – played – played*	
Prepositions	Prepositions are used to show a relationship in space or time or a logical connection between two or more people, places or things.	They are: *under*, *to*, *on*, *in*, *at*, *near* (*at* home, *on* Wednesday, *in* the street).	The meaning of prepositions in the Ukrainian language does not coincide with the ones in English.
Adjectives	They give us more information about animals, people, or things represented by pronouns and nouns. See *Degrees of comparison*.	It does not change in number, gender and case (a *long* holiday, a *happy* end, a *tall* boy).	It changes in the number, gender and case.
Possessive case	There are a few different ways to form the noun possessive.	With the addition of '*s* (or sometimes just the apostrophe), a noun can change from a simple place, person, or thing to a place, person, or thing that owns something: John'*s* father.	The word forms differ only in respect of inflections: *mama*- mam-**yn**, *tato –* *tato*-**vyi**.
Possessive pronouns	We use possessive pronouns in place of a noun.	They are *mine, yours, his, hers, ours, theirs.*	They are *mii* (mine), *tvii* (your), *yoho* (his), *yii* (hers), *nash* (ours), *yikhnii* (theirs).
Adverbs	We use adverbs to add more information about an adjective, a verb, another adverb, a clause or a whole sentence and, less commonly, about a noun phrase.	He speaks *slowly.*	Vin hovoryt *povilno* (He speaks *slowly).*
Quantifiers	Quantifiers include the words like *enough, fairly, hardly, quite, rather*.	They are applicable in the language (The film was *quite* good).	Applicable in the language.
Indefinite tenses	It is a verb tense category. It covers the simple present tense, the simple past tense, and the simple future tense. The three indefinite tenses express facts or habitual activities.	They *dance* well. He *lived* in Kyiv.	Not specified.
Sentences	There are four main types of sentence: affirmative, interrogative, imperative, exclamative.	The word order is direct.	The word order is loose.
Tag questions	A phrase, which is added to a sentence for emphasis, or to turn it into a question, usually gets agreement or check information.	It is applicable. (He speaks English, *does not he*? He does not speak English, *does he*?).	Not specified.
Affirmative sentence	A sentence makes a statement or states a fact (He speaks English. He does not speak English. We like classical music).	The word order is direct.	The word order is loose.

Compound nouns/pronouns	A noun/pronoun is made up of two or more different words.	*Cakeshop, schoolboy, somebody, nowhere*	*Khto-nebud* (somebody), *vukhohorlonis* (otolaryngologist).
Wh-questions	A question which starts with *who* (*m*), *what, when, which, why, where, whose.*	The word order is direct.	The word order is loose.
Conjunctions	Conjunctions are linking words like *and, or, but, then* and *because.*	He likes hard rock *but* I like classical music.	Yomu podobaietsia tiazhkyi rok, *ale* meni podobaietsia klasychna muzyka (Йому подобається тяжкий рок, *але* мені подобається класична музика).
Continuous tenses	Continuous tenses are used to show that an action is still in motion (has not finished). To form the continuous tense we use *to be + V-ing.*	Continuous Tenses are used when describing a particular point in time. In the Present Continuous Tense, we are discussing something that is happening now: She *is writing*). Past Continuous Tenses are used to describe a past action that occurred over a period: She *was writing*. The Future Continuous Tense is used for certain specific future arrangements and plans: She *will be writing*.	It is not specified.
Conditional mood	It considers imagined or uncertain situations and the possible results of these situations. The most common types of conditional sentences involve *if*.	It exists in the language.	It is not specified.
-ing forms	A verb, adjective or noun, which ends in *-ing*.	I like *reading*. He is *reading* a *boring* book.	It is not specified.
Phrasal verbs	Phrasal verbs have two parts: the main verb and an adverb particle. Phrasal verbs often have meanings, which we cannot easily guess from their individual parts.	The book first *came out* in 1997 (was published).	It is not specified.
Tenses of a verb	Tenses refer to different forms of a verb or verb phrase. We use different tenses to talk or write about different times.	Taking into account aspect and future modals – there are 12 tenses in English.	It has three forms of a verb which is time declined.
Time expressions	They are adverbs, which show when an action happens.	*last year, today, in* 1994, *on Sunday*	They are the same.

Noun acts as a subject of a sentence (A *boy* plays), an object (I have a *book*), a predicate complement (My brother is a *doctor*), an adjective or modifier of another noun (a *stone* house), adverbial modifier (together with a preposition Victor is *in London*) [3]. Nouns are divided into proper and common. Proper nouns include the names of people (Kovalenko, Bill, Victor), geographical names (England, Lviv,

Konotop), names of streets, newspapers, magazines, etc. In fact, English proper nouns almost fully coincide with the corresponding nouns in the Ukrainian language. It should be noted that days of the week, months, nationalities, etc., are written in capital letters.

Pronoun is a word that substitutes a noun phrase or noun. There are a few different types of pronouns: personal (*I*, *we*, *you*, *they*, *he*, *she*, *it*), possessive, reflexive, demonstrative, interrogative, relative, and indefinite pronouns. Let us consider the categories of the following pronouns: personal, possessive and demonstrative [3]. Personal pronouns act as subject (*I*, *we*, *you*, *they*, *he*, *she*, *it*) and object (*me*, *us*, *you*, *them*, *him*, *her*, *it*) pronouns. There are two types of possessive pronouns: possessive determiners and possessive pronouns. We use possessive determiners before a noun: *my* (*mii*, *moia*, *moie*, *moi*), *our* (*nash*, *nasha*, *nashe*, *nashi*), *your* (*tvii*, *tvoia*, *tvoie*, *tvoi*, *vash*, *vasha*, *vashe*, *vashi*), *their* (*yikhnii*, *yikhnia*, *yikhnie*), *his* (*yoho*), *her* (*yii*), *its* (*yikh*). We use possessive pronouns in place of a noun: *mine* (*mii*, *moia*, *moie*, *moi*), *ours* (*nash*, *nasha*, *nashe*, *nashi*), *yours* (*tvii*, *tvoia*, *tvoie*, *tvoi*, *vash*, *vasha*, *vashe*, *vashi*), *theirs* (*yikhnii*, *yikhnia*, *yikhnie*), *his* (*yoho*), *hers* (*yii*), *its* (*yikh*). In the following sentences, the pronouns function as object pronouns, subject pronouns and possessive determiners: *I give him my book/You give us your book/We give them our book/She gives you her book/He gives me his book/They give her their book*. Demonstrative pronouns are pronouns that point to specific objects. They take the place of a noun phrase, activity, noun, or situation. They always consist of *those, that, these, this* (Table 4) [3].

Table 4
Demonstrative pronouns

Singular	Translation	Example	Plural	Translation	Example
This	Tsei, tsia, tse	This is a book.	These	Tsi	These are books.
That	Toi, ta, te	That is book.	Those	Ti	Those are books.
The same	Toi (ta, te) samyi	The same book	The same	Ti zh sami	The same books
Such	Takyi	Such a book	Such	Taki	Such books

Adjectives are four major word classes and verbs, nouns, and adverbs [3]. They give us more content about animals, people, or things represented by pronouns and nouns. They describe or modify the features and qualities of animals, people, and things. Adjectives in English do not change in cases, numbers or genders. Adjectives are divided into simple adjectives (*good*, *cold*, *young*), derivative (*international*, *important*, *beautiful*), and compound (*time-consuming, well-organized*). According to the meaning, adjectives are divided into relative (*a brick wall*, *a wooden table*) and descriptive adjectives (*cold*, *beautiful*). Descriptive adjectives are used to provide more information to a noun by describing or modifying it. They have degrees of comparisons and are complimented with an adverb (*very*, *quite*, *so*, *too*, *rather*, etc.). To form the degrees of comparison, we use the suffixes *-er, -est*; add the words *more*, or change the word.

1. To form the comparative and superlative degree of one syllable or two-syllable adjectives (ending in *-y*, *-le*, *-er*, *-ow*), we use the *–er/-est* suffix. We normally use *the* before a superlative adjective (Table 5). Two-syllable adjectives ending in *consonant+y* change *y* to *i* and take the *-er* and *-est* endings (*busy – busier – (the) busiest*). One-syllable adjectives ending in *short vowel+consonant* double the consonant after adding *-er/-est* (*big – bigger – (the) biggest*). Adjectives ending in *-e* add only *-r/st* to make comparative or superlative degree (*simple – simpler – (the) simplest*) [3].

Table 5
One-syllable and two-syllable adjectives

No	Positive degree	Comparative degree	Superlative degree
1	Busy	Busier	The busiest
2	Big	Bigger	The biggest
3	Simple	Simpler	The simplest
4	Clever	Cleverer	The cleverest
5	Young	Younger	The youngest
6	Wide	Wider	The widest

| 7 | Hot | Hotter | The hottest |
| 8 | Narrow | Narrower | The narrowest |

2. Adjectives of two (not ending in -er, -le, -y, -ow) or more syllables form the superlative with *most/least* and the comparative with *more/less* (Table 6) [3].

Table 6
Adjectives of two or more syllables with more/most

No	Positive degree	Comparative degree	Superlative degree
1	international	more international	the most international
2	important	more important	the most important
3	beautiful	more beautiful	the most beautiful

To show the diminishing degree, we use the words *less*, *the least* (Table 7) [3].

Table 7
Adjectives of two or more syllables with less/least

No	Positive degree	Comparative degree	Superlative degree
1	difficult	less difficult	the least difficult

3. Some adjectives have irregular forms (Table 8) [3]. The adjective *little* used in the meaning of *small* (a little girl) forms degrees of comparisons as following: *the smallest* girl, a *small* girl. The adjective *old* has forms *elder, the eldest* when it concerns family members.

Table 8
Irregular forms

No	Positive degree	Comparative degree	Superlative degree
1	far	further	furthest
2	much	more	the most
3	good	better	the best
4	many	more	the most
5	bad	worse	the worst
6	little	less	the least

4. When comparing the qualities of two objects, we use *than* (ніж [nizh]) after the adjective in comparative degree: In winter, the days are shorter *than* the nights.

5. To avoid repetition of the name of the same object, we use the word *one*: This room is larger than that *one*.

6. To compare two objects of the same quality, an adjective in the positive degree is used, and it is placed between the conjunctions *not as... as*, *as... as*: This book is *not as* interesting *as* that one. This book is *as* interesting *as* that one. (Table 9) [3].

Table 9
Adjective suffixes

No	Adjective suffixes	Example	No	Adjective suffixes	Example
1	-y	frosty	8	-ish	blackish
2	-some	tiresome	9	-ic(al)	historic(al)
3	-ous	famous	10	-en	wooden
4	-ly	friendly	11	-ary(ory)	revolutionary
5	-less	useless	12	-ant(ent)	pleasant, different
6	-ful	useful	13	-able(ible)	changeable, sensible
7	-ive	progressive;			

Verbs are one of the four major word classes and nouns, adjectives, and adverbs [3]. A verb refers to an action (*to play – hraty*), event or state (*to love – kohaty*). Verbs are divided into *simple* verbs (*to*

do – robyty, *to speak – rozmovliaty*, *to tell – rozpovidaty*, etc), *derivative* verbs which are formed with prefixes and suffixes (*to dislike – ne podobatysia*, *to widen – rozshyriuvaty*, and others), and *compound* verbs – made up of one or more words (*to babysit – dohliadaty ditei*, *to whitewash – bilyty*, etc.). English verb is used in different tenses to talk or write about different times. The system of English tenses has common and different features in comparison with the Ukrainian one. As in the Ukrainian language, English has a very extensive system of grammatical tenses. In some cases, they may coincide in some ways in both languages, and in others – differ in both form and meaning. It is the last factor – the tense differences that causes considerable difficulties in learning English grammar. First, the base form of the verb is infinitive, and it is common in both languages, but the differences between them are significant. In the Ukrainian language, there is one form of the infinitive (*buty – to be*, *maty – to have*, *spodivatysia – to hope*, *chytaty – to read*, *rozmovliaty – to speak*, *chuty – to hear*, *strybaty – to jump*) while in English, there are six forms of the infinitive. As in the Ukrainian language, all other verb forms are made from the infinitive. Verb forms express person, number, tense, state, mode of action and function as a predicate. According to the meaning and their functioning in the sentence, English verbs are divided into notional, auxiliary, modal and linking verbs (Table 10) [3].

Table 10

English verb

Notional verbs have a whole lexical meaning of their own.	to be (buty), to do (robyty), to have (maty), to speak (rozmovliaty), to jump (strybaty), to read (chytaty) and others.
Linking verbs are verbs that serve as a connection between a subject and further information about that subject.	to be (buty), to get (otrymuvaty), to become (stavaty), to grow (rosty) and others.

The main forms of the verb are [3]:
1. The infinitive, e.g. *work, take*;
2. The past form, e.g. *worked, took*;
3. The past participle, e.g. *worked, taken*;
4. The *-ing* form, e.g. *working, taking*;
5. The third-person singular present simple e.g. *works, takes*.

In English, there are twelve tenses; verbs come in three tenses: future, present, and past. English verbs also have a special form called future-in-the-past, which shows a future action from the past.

The simple present tense is one of several forms of the present tense in English. It is used to describe fixed arrangementsб general truths, unchanging situations, and habits. The simple present tense is formed out of the base form of the verb: *I take*, *you take*, *we take*, and *they take*. The third-person singular takes an *-s* at the end: *he takes*, *she takes*. Verbs ending in *consonant + y* change the *-y* to *-ies* in the third person: *she cries* (vona krychyt); but if there is *vowel + y* no changes occur: *he plays* (vin hraie). The following time expressions are used in the present simple: *often*, *always*, *every day*, *every week*, *every month*, *every year*, etc. The pronunciation and spelling rules of the ending *-s/es* are the same as for the plural nouns [3]:

We *read* newspapers every day (My *chytaiemo* hazety shchodnia [Ми *читаємо* газети щодня]).

She *speaks* English (Vona *rozmovliaie* anhliiskoiu [Вона *розмовляє* англійською]).

The earth *rotates* round the sun (Zemlia *obertaietsia* navkolo Sontsia [Земля *обертається* навколо Сонця]).

The simple past is a verb tense used to talk about things that happened or existed before now. It shows that you are talking about something that has already happened. Regular verbs form past simple tense by adding *-ed* to the root form of the verb (or just *-d* if the root form already ends in an *-e*). We should remember the records of irregular verbs: *speak – spoke*, *buy – bought*, *write – wrote*. Time expressions used with the past simple are *a year ago*, *a month ago*, *a week ago*, *last year*, *last month*, *last week*, *yesterday*, *in* 2021 [3].

Future Simple tense is used when there is no plan or decision to do something before we speak. We make the future simple with the modal auxiliary *will*. The structure of the future simple tense is *subject + auxiliary will + main verb*: They will come tomorrow. Time expressions used with the future simple:

in 2025, *in a week*, *next year*, *next month*, *next week*, *tomorrow*, and others. (*They will come tomorrow.*) present simple and present continuous is used to refer to events in the future [3]:

1. They are facts, or because there is a clear or fixed schedule or timetable: He *goes* to Kyiv tomorrow (Vin *yide* do Kyieva zavtra [Він *їде* до Києва завтра]).

2. They are a part of conditional sentences of time and consession: If you *buy* this book, show it to me (Yakshcho vy *kupyte* tsiu knyzhku, pokazhit yii meni [Якщо ви *купите* цю книжку, покажіть її мені]).

The mood is the form a verb takes to show how it is to be regarded (e.g., as an uncertaintyб, a wish, a command, a fact). English has indicative, imperative, and subjunctive moods; other moods, such as the conditional, do not appear as morphologically distinct forms [3].

1. An indicative mood is a verb form that makes a statement or asks a question. The vast majority of verbs in sentences are in the indicative mood. It shows that the action is real to occur in the present, past or future: Peter *speaks* English (Piter *rozmovliaie* anhliiskoiu [Пітер *розмовляє* англійською]); Peter *spoke* English (Piter *rozmovliav* anhliiskoiu [Пітер *розмовляв* англійською]); Peter *will speak* English (Piter *rozmovliatyme* anhliiskoiu [Пітер *розмовлятиме* англійською]).

2. Imperative mood most commonly functions as commands, instructions or orders. We do not usually include the subject in an imperative clause. We use the base form of the verb: *Read*! (*Chytai*! [*Читай*!] or *Chytaite*! [*Читайте*!]). In modern English, there is only one form for the second person singular and plural. The Ukrainian translation of imperatives depends on the person the action is addressed to. In Ukrainian, we will say *Chytai!* in second-person singular, and if we address the action to an older or unfamiliar person or more than one person, then we will say *Chytaite*!

3. Conditional sentences consider imagined or uncertain situations and the possible results of these situations. The most common types of conditional sentences involve *if/when*. The subjunctive mood shows a wish, suggestion, demand, or condition contrary to fact. This type of sentences in Ukrainian is used with the particle *by*: Yakby ya znav (If I knew [Якби я знав…]), Vin pishov by…, yakby (He would go … if… [Він пішов би…, якби…]).

Verb Types. English verbs are divided into notional, auxiliary, modal and linking verbs (Table 11).

Table 11

Types of English verbs

No	Verb types	Meaning	Example
1	Notional	Verbs have a full lexical meaning	to justify, to speak, to have, to be, to do, to read etc.
2	Auxilary	Verbs do not have an own lexical meaning	will, should, shall, to have, to be, to do, would
3	Modal/linking verbs	Verbs are partially nominative	must, may, can, would, will, should, shall, to have to, to be to, need to, ought to

A verb can also be described as **intransitive** or **transitive** based on whether it requires an object to express a complete thought or not. A transitive verb is the one that only makes sense if it exerts its action on an object: *to buy, to read, to ask* etc.: I *asked* them. An intransitive verb will make sense without one: *to live*, *to go*, *to wor*k, and others: He *goes* home. Some verbs may use both ways: *to move, to stop, to open* (*He stopped at once. He stopped a taxi.*)[3].

In English grammar, as well as in Ukrainian, the two grammatical voices are active and passive. Active voice means that a sentence has a subject that acts upon its verb: I *asked* him (Ya *zapytav* yoho [Я *запитав* його]). Passive voice means that an issue is a recipient of a verb's action: I *was asked* (Mene *zapytaly* [Мене *запитали*]). Most regular verbs use the root form in the simple present, except in the third-person singular (which ends in *-s*). The simple past tense and the past participle are formed depending on whether the verb is regular or irregular.

Regular past simple and past participle forms are formed by adding *-ed* to the infinitive of the verb: *to open – open**ed** – open**ed**; to want – want**ed** – want**ed***. However, there are some spelling rules [3]:

1. If a verb ends in a consonant and *-y*, you take off the *-y* and add *-ied*: *to cry – cr**ied** – cr**ied***. However, if the word ends in a vowel and *-y*, you add *-ed*. (*to play – play**ed** – play**ed***).

2. If a verb ends in *-e*, you add *-d*: *to move – moved – moved*, *to live – lived – lived*.

3. If a verb ends in a vowel and a consonant, the consonant is usually doubled before *-ed*: *to stop – stopped – stopped*, *to drop – dropped – dropped*.

4. Two syllable and multi-syllable words that end in one short vowel double the final consonant if the stress is on the final syllable: *to refer – referred – referred*, *to permit – permitted – permitted*.

5. In the American spelling of words ending in *consonant + e + l*, the final *l* will not double in the most commonly accepted form (e.g., *cancel → canceled*, *travel → traveled*). Most other English-speaking countries prefer to double the final *l* (e.g., *cancel → cancelled*, *travel → travelled*).

The verb *to do* has two forms – *do* and *does* in the present tense and *did* in the past. The negative forms are: *did not – didn't, do not – don't, does not – doesn't*. The verb is used as:

1. A finite verb meaning *to do, to perform*: What will you *do* tomorrow? (Shcho ty *robytymesh* zavtra? [Що ти *робитимеш* завтра?]), We *did* our work yesterday (My *vykonuvaly* svoiu robotu vchora [Ми *виконували* свою роботу вчора]).

2. The primary function of *to do* is to act as an auxiliary verb. It is used to form questions and negative statements in the present simple and simple past tenses: He *does* not know this rule (Vin ne znaie tsoho pravyla [Він не знає цього правила]), He *did* not meet them (Vin ne zustriv yikh [Він не зустрів їх]), *Don't* be late! (Ne spizniuitesia! [Не спізнюйтеся!]), *Don't* do these exercises! (Ne vykonuite tsykh vprav! [Не виконуйте цих вправ!]). It is also used to make negative statements for the imperatives. The verb *to do* has two conjugations in the simple present: *do / does*.

3. The verb *to do* is also used as an auxiliary verb in affirmative statements to emphasise: *Do* come in! (Ta zakhodte zh! [Та заходьте ж!]) or He *did* come (Vin use zh pryishov [Він усе ж прийшов]).

4. In order to avoid a repetition of the finite verb, we use *to do* instead: He worked as well as I *did* (Vin pratsiuvav tak samo dobre, yak i ya [Він працював так само добре, як і я]).

The most common verb *prefixes* are *un-* (*to unload, to undo, to untie*), *dis-* (*to disarm, to disappear, to discharge*), *re-* (*to rewrite, to retell, to reconstruct*). The most common suffixes are: *-ate* (*to separate, to graduate, to demonstrate*), *-ize* (*to memorize, to organize, to mobilize*), *-fy* (*to simplify, to clarify, to signify, to magnify*), *-en* (*to broaden, to shorten, to strengthen*) [3].

We use *do* and *does* to make *questions* with the present simple. We use *does* for the third person singular (*she/he/it*) and *do* for the others (Tables 12-14). We use *do* and *does* to make negatives with the present simple. We use *doesn't* for the third person singular (*she/he/it*) and *don't* for the others [3].

Table 12
Present Simple tense

Affirmative forms		Interrogative forms			Negative forms		Negative interrogative forms		
I, we, you, they	write	Do	I, we, you, they	write?	I, we, you, they	do not (don't) write	Do	I, we, you, they	not write?
He, she, it	writes	Does	he, she, it	write?	He, she, it	does not (doesn't) write	Does	he, she, it	not write?

Table 13
Past Simple tense

Affirmative forms		Interrogative forms			Negative forms		Negative interrogative forms		
I, we, you, they, he, she, it	wrote	Did	I, we, you, they, he, she, it	write?	I, we, you, they, he, she, it	did not (didn't) write	Did	I, we, you, they, he, she, it	not write?

Verbs *to be* and *modals* (*can, may, must*) form negative forms, interrogative and negative interrogative forms without an auxiliary verb. The verb *to have* makes these forms both with and without the auxiliary verbs (Table 12). In the past simple we form questions and negative interrogative forms with the verb *did* (do in the past) + the infinitive (Table 13) [3]. In English, it is pretty difficult to process these rules. However, the more detailed they are, the easier it is to program. It is complicated to automate the texts when there are many rules, exceptions and patterns. Let us give you an example.

The verb *to run* [rʌn] is an irregular one and has the following three forms in English: *run*, *ran*, *run*. Its translation into Ukrainian has14 options [3]:

бігати [bihaty], *бігти* [bihty], *гнати* [hnaty], *тікати* [tikaty], *котитися* [kotytysya], *ковзати* [kovzaty], *слідувати* [sliduvaty], *рухатися* [rukhatysya], *курсувати* [kursuvaty], *здійснювати втечу* [zdiysnyuvaty vtechu], *протікати* [protikaty], *відбуватися* [vidbuvatysya], *мигогіти* [myhotity], *проноситься* [pronosyt'sya].

Table 14

Future Simple tense

Affirmative forms		Interrogative forms			Negative forms		Negative interrogative forms		
I, we	shall write	Shall	I, we	write?	I, we	shall not (shan't) write	Shall	I, we	not write?
you, they, he, she, it	will write	Will		write?	you, they, he, she, it	will not (won't)write	Will	you, they, he, she, it	not write?

The verb *to run* has many shades of meaning, so we will try to classify single-root words according to their part of speech. Depending on the sentence structure, only the first meaning of the word *to run* [rʌn] has 36 choices of the appropriate verb form in the Ukrainian language and 60 variants in the Russian language (Table 15). It means that about 14 meanings of the verb *to run* [rʌn] may lead to about 500 options of its translation [3].

Table 15

Forms of the verb *to run* in English, Ukrainian and Russsian

No	English	Ukrainian	Russian
1.	run	бігати [bihaty]	бегать [begat']
2.		біг [bih]	бег [beg]
3.		біжите [bizhyte]	бежите [bezhite]
4.		біжать [bizhat']	бегут [begut]
5.		біжи [bizhy]	беги [begi]
6.		біжіть [bizhit']	бегите [begite]
7.	I run	бігаю [bihayu]	бегаю [begayu]
8.		біжу [bizhu]	бегу [begu]
9.	let's run	біжимо [bizhymo]	бежим [bezhim]
10.		бігаємо, бігаєм [bihayemo, bihayem]	бегаем [begayem]
11.		біжімо [bizhimo]	побежали [pobezhali]
12.	you run	бігаєш [bihayesh]	бегаешь [begayesh']
13.		бігаєте [bihayete]	бегаете [begayete]
14.		бігай [bihay]	бегай [begay]
15.		біжиш [bizhysh]	бежишь [bezhish']
16.		бігайте [bihayte]	бегайте [begayte]
17.	runs	бігає [bihaye]	бегает [begayet]
18.	ran	бігав [bihav]	бегал [begal]
19.		бігала [bihala]	бегала [begala]
20.		бігало [bihalo]	бегало [begalo]
21.		бігали [bihaly]	бегали [begali]
22.		бігла [bihla]	бежала [bezhala]
23.		бігло [bihlo]	бежало [bezhalo]
24.		бігли [bihly]	бежали [bezhali]
25.	I will run	бігтиму [bihtymu]	побегу [pobegu]
26.	you will run	бігтимеш [bihtymesh]	побежишь [pobezhish']
27.	you will run	бігтимете [bihtymete]	побежите [pobezhite]
28.	will run	бігтиме [bihtyme]	побежит [pobezhit]
29.	we will run	бігтимемо [bihtymemo]	побежим [pobezhim]
30.	will run away	бігтимуть [bihtymut']	побегут [pobegut]
31.	running	бігають [bihayut']	бегают [begayut]

32.	бігаючи [bihayuchy]	бегая [begaya]
33.	біжить [bizhyt']	бежит [bezhit]
34.	біжучи [bizhuchy]	бегучи [beguchi]
35.	бігаючи [bihayuchy]	бегающий [begayushchiy]
36.		бегающая [begayushchaya]
37.		бегающее [begayushcheye]
38.		бегающие [begayushchiye]
39.		бегающего [begayushchego]
40.		бегающей [begayushchey]
41.		бегающих [begayushchikh]
42.		бегающему [begayushchemu]
43.		бегающим [begayushchim]
44.		бегающую [begayushchuyu]
45.		бегающею [begayushcheyu]
46.		бегающими [begayushchimi]
47.		бегающем [begayushchem]
48.	бігши [bihshy]	бегавший [begavshiy]
49.		бегавшая [begavshaya]
50.		бегавшее [begavsheye]
51.		бегавшие [begavshiye]
52.		бегавшего [begavshego]
53.		бегавшей [begavshey]
54.		бегавших [begavshikh]
55.		бегавшему [begavshemu]
56.		бегавшим [begavshim]
57.		бегавшую [begavshuyu]
58.		бегавшею [begavsheyu]
59.		бегавшими [begavshimi]
60.		бегавшем [begavshem]

In addition, the main forms of the verb *to run* have about a dozen of less used meanings of the word in the Ukrainian language, for example [3]:

вбігати [vbihaty], *вибігати* [vybihaty], *добігати* [dobihaty], *забігати* [zabihaty], *набігати* [nabihaty], *оббігати* [obbihaty], *відбігати* [vidbihaty], *перебігати* [perebihaty], *побігати* [pobihaty], *підбігати* [pidbihaty], *пробігати* [probihaty], *збігати* [zbihaty], *вбігти* [vbihty], *вибігти* [vybihty], *добігти* [dobihty], *забігти* [zabihty], *набігти* [nabihty], *відбігти* [vidbihty], *перебігти* [perebihty], *прибігти* [prybihty], *підбігти* [pidbihty], *пробігти* [probihty], *забігати* [zabihaty], *набігатися* [nabihatysya], *пробігтися* [probihtysya], *розбігтися* [rozbihtysya], *збігтися* [zbihtysya], *убігати* [ubihaty].

Moreover, each word has about 38 variants of forms depending on the sentence structure and context (more than 1000 word forms). However, translating the word *to run* into Ukrainian may take the meaning of a noun, adjective, adverb, participle and a separate compound word. What is more, the noun and adjective have their form of declension (7 cases in Ukrainian), for example [3]:

- Noun: *біг* [bih], *бігання* [bihannya], *біганина* [bihanyna], *бігун* [bihun], *бігунка* [bihunka], *біженець* [bizhenets'], *біженка* [bizhenka], *біженство* [bizhenstvo], *вибіг* [vybih], *вибігання* [vybihannya], *забіг* [zabih], *забігайлівка* [zabihaylivka], *забігання* [zabihannya], *набіг* [nabih], *набігання* [nabihannya], *перебігання* [perebihannya], *перебіжчик* [perebizhchyk], *перебіжчиця* [perebizhchytsya], *побігайчик* [pobihaychyk], *побігеньки* [pobihen'ky], *пробіг* [probih], *пробіжка* [probizhka], *перебігання* [perebihannya], *розбіг* [rozbih], *розбіжка* [rozbizhka], *збігання* [zbihannya].
- Adjective: *побіжний* [pobizhnyy], *біговій* [bihoviy], *біженський* [bizhens'kyy], *набіганий* [nabihanyy], *збіганий* [zbihanyy], *вибіганий* [vybihanyy], *забіганий* [zabihanyy], *пробіганий* [probihanyy], *перебіганий* [perebihanyy], *розбіганий* [rozbihanyy].

- Adverb: *побіжно* [pobizhno], *бігом* [bihom], *перебіжкою* [perebizhkoyu], *набігом* [nabihom], *набігу* [nabihu], *забігом* [zabihom], *вибіганням* [vybihannyam], *забігом* [zabihom], *набіганням* [nabihannyam], *перебіганням* [perebihannyam], *перебіжчиком* [perebizhchykom], *пробігом* [probihom], *розбігом* [rozbihom], *збігом* [zbihom].
- Verb (extra shades of meaning are developed with the help of various prefixes): *вбігати* [vbihaty] – *вбігаючи* [vbihayuchy], *вибігати* [vybihaty] – *вибігаючи* [vybihayuchy], *розбігтися* [rozbihtysya] – *розбігаючись* [rozbihayuchys′], etc.
- Compoud words of different speech parts: *автопробіг* [avtoprobih], *велопробіг* [veloprobih], *мотопробіг* [motoprobih], etc.

Article. English has two types of papers: definite *the,* and indefinite *a/an.* They are a determiner type, and they go before a noun [3].

The definite article limits the meaning of a noun to one particular thing. *The* before a noun shows that what is referred to is already known to the listener, speaker, reader and/or writer. The definite article can be used with singular, plural, or uncountable nouns.

Definite article is used before [3]*:*

1. Nouns that are preceded by:

a) Cardinal numbers – He was the *first* to come. (Він прийшов *першим* [Vin pryishov *pershym*]);

b) An adjective in the superlative degree – This is the *most beautiful* flower. (Це *найкрасивіша* квітка [Tse *naikrasyvisha* kvitka]);

c) An adjective *following*, *same, next, last*: Answer the *following* questions (Дайте відповіді на *такі* питання [Daite vidpovidi na *taki* pytannia]).

But: *next door* (сусідній будинок [susidnii budynok], сусідня кімната [susidnia kimnata]), *next week/month, summer, year, Sunday* (наступного тижня [nastupnoho tyzhnya], misiatsia [місяця], літа [lita], року [roku], неділі [nedili]), *last week/month, year, Saturday* (минулого тижня [mynuloho tyzhnia], misiatsia [місяця], року [roku], суботи [suboty]) and others [3].

2. *The* is used with singular and plural nouns, countable and uncountable ones, to talk about something specific, or when the noun is mentioned for the second time: This is the man *I told you about.* (Це чоловік, про якого я вам розповідав [Tse cholovik, pro yakoho ya vam rozpovidav]).

3. We use *the* for the things known to everyone (*the earth*, *the moon*, *the stars*, *the sun*, *the planet*) because they are a part of our physical environment or part of the natural world.

4. In expressions: *the other day* (днями [dniamy]), *on the right* (праворуч [pravoruch]), *on the left* (ліворуч [livoruch]), *in the afternoon* (після обіду [pislia obidu]), *in the evening* (увечері [uvecheri]), *in the morning* (вранці [vrantsi]), and others.

5. In expressions *the more ... the better ...* (чим більше … тим краще … [chym bilshe … tym krashche …]): *The more* we learn, *the more* we know (*Chym bilshe* my vchymos, *tym bilshe* my maiemo [*Чим більше* ми вчимось, *тим більше* ми маємо]).

6. Names of families: *the Browns* (сім'я Браунів [simia Brauniv], Брауни [Brauny]).

7. Names of newspapers/magazines and ship: *the News from Ukraine, the Daily Mail, the Guardian*.

8. Names of nationalities in *-ch, -sh, or -ese*: *the Chinese* (китайці [kytaytsi]), *the English* (англійці [anhliytsi]). Other plural nationalities are used with or without *the* (*the Ukrainians* – українці [ukrayintsi], *the Americans* – американці [amerykantsi]).

9. When we talk about particular groups or people within society, we use the + adjective: *the poor* (бідні [bidni]), *the unemployed* (безробітні [bezrobitni]).

10. Groups of states: *the USA* (США [SShA]), *the Netherlands* (Нідерланди [Niderlandy]), *the United Kingdom* (Об'єднане Королівство [Obiednane Korolivstvo]).

11. We use *the* with mountain ranges and some mountains, names of oceans, seas, rivers, islands groups, deserts: *the Dnieper* – Дніпро [Dnipro], *the Thames* – Темза [Temza], *the Crimea* – Крим [Krym], *the Black Sea* – Чорне море [Chorne more], *the Atlantic Ocean* – Атлантичний океан [Atlantychnyy okean]*, the Gobi Desert, the West Indies*.

12. Uncountable nouns when a limited amount is meant: *The water* is frozen (*Вода* замерзла [*Voda* zamerzla]), Give me *the bread*, please (Дайте мені, будь ласка, *хліба* [Daite meni, bud laska, *khliba*]), *Water* is a liquid (*Вода* – рідина [*Voda* – ridyna]).

13. *The* is used to refer to a class of people, animals or things: *The rose* is a beautiful flower (*Троянда* – красива квітка [*Troianda* – krasyva kvitka]).

Definite article is omitted before [3]*:*

1. Titles with proper names: *Professor* Snow, *Mister* Morgan.

2. Names of cities, streets, squares: *Oxford Street, Trafalgar Square, London* (but: the Red Square, the Hague).

3. Names of days, months, seasons: *in April, on Wednesday, in summer*. However, if we mean a certain year, then the season name is preceded by the definite article: in *the winter* of 2015.

4. The names of abstract and substance nouns, which are not countable: *freedom* (воля [volia]), *metal* (метал [metal]).

5. Proper names: *Victor, Andrew, Kovalenko, Webster*.

6. Names of countries: *Canada, Africa*, etc.

7. The words *breakfast* (сніданок [snidanok]), *lunch* (ланч [lanch]), *dinner* (обід [obid']), *supper* (вечеря [vecheria]) used with a general meaning: We have *breakfast* at 8 o'clock (Ми *снідаємо* о восьмій [My *snidaiemo* o vosmii]).

8. With some expressions [3]:
- *at night* (вночі [vnochi]),
- *by tram/train/plane/ship*, etc (трамваєм [tramvaiem], потягом [potiahom], litakom [літаком]),
- *from morning till night* (з ранку до вечора [z ranku do vechora]),
- *to go to bed* (лягати спати [liahaty spaty]),
- *day after day* (день за днем [den za dnem]),
- *by heart* (напам'ять [napamiat]),
- *to go to school* (ходити до школи [khodyty do shkoly]),
- *at home* (вдома [vdoma]) etc.

A/an is used to refer to a non-specific or non-particular member of the group.

We use indefinite article [3]*:*

1. To indicate membership in a group: My brother *is a doctor*.

2. With a noun after *there is* (*there will be, there was*): *There is a table* in the middle of the room (Посередині кімнати *стоїть стіл* [Poseredyni kimnaty *stoit stil*]).

3. With an object after the verb *to have*: I *have a brother*.

4. Before singular nouns after the words *quite, rather, such*, etc.: She is *such a good pupil*.

5. After *what* in exclamations: *What a good idea*! But: *What beautiful music*!

6. With the words: *a bit* (трохи [trochy]), *a little* (трохи [trochy]), *a few, a lot* (кілька [kilka]), and others: He speaks English *a little* (Він *трохи* розмовляє англійською [Vin *trochy* rozmovliaie anhliiskoiu]).

7. In the meaning *one* (один [odyn]) before numerals: *a hundred* (одна сотня [odna sotnia]), *a thousand* (одна тисяча [odna tysiacha]), *a million* (один мільйон [odyn million]), *a dozen* (дюжина [diuzhyna]): The library has *a hundred* books (Бібліотека налічує *сто* книг [Biblioteka nalichuie *sto* knyh]). They have *three* meals a day (Вони їдять *тричі* в день [Vony yidiat *trychi* v den]).

We do not use an indefinite article before abstract and uncountable nouns.

Simple and compound sentences. English word order is strict and relatively inflexible. English relies on word order to show relationships between words in a sentence, as there are few endings in English, which show person, number, case and tense. It is since, unlike the Ukrainian (synthetic) language, English is an analytical one. In Ukrainian, we rely on word endings to tell us how words interact in a sentence. To illustrate this, we will consider the Ukrainian sentence *Учень читає книгу* [Uchen chytaie knyhu] (*A pupil reads a book*). Without altering the meaning of the sentence, we may change the word order: *Книгу учень читає* [Knyhu uchen chytaie], Читає книгу учень [Chytaie knyhu uchen] etc. The English sentence: *A pupil reads a book* does not allow inverting words. How do you explain this? In the Ukrainian language, the word-forming suffixes enable such changes, and the most common pattern of basic word order in English declarative sentences is Subject + Predicate + Object, which forms the base of the sentence. The adverbial modifier is placed after the object (or after the verb if there is no object). The attribute (an adjective) is placed before its noun (markers in the form of a noun with a preposition are placed after their nouns) (Fig. 2) [3].

Subject answers the questions *Who*? (хто? [khto?]), *What*? (що? [shcho?]), and is typically nouns (The *telephone* is on the table), gerund (*Playing chess* is his hobby), adjectives (The *poor* became poorer and the *rich* became richer), pronouns (*It* is on the table), infinitive (*To create* means to work), object clauses (*That he speaks good English* is well-known), numerals (*Fifty* and *two* make fifty-two) [3].

Predicate answers the question *What is it*? (який він? [yakyi vin?]), *What does a subject do*? (що робить підмет? [shcho robyt pidmet?]), *What* (who) is it? (що/хто це? [shcho/khto tse?]), *What is done to a subject*? (що робиться з підметом? [shcho robytsia z pidmetom?]). Predicates can be divided into two main categories: action and state of being. Predicates that describe an action can be simple, compound, or complete. A simple predicate is a verb or verb phrase without any modifiers or objects (Ira cooked). A compound predicate is a combination of two or more verbs or verb phrases (Ira cooked and baked). A complete predicate includes a verb phrase or verb with modifiers and/or objects (We *want to watch TV*. My brother *can speak* English.) [3].
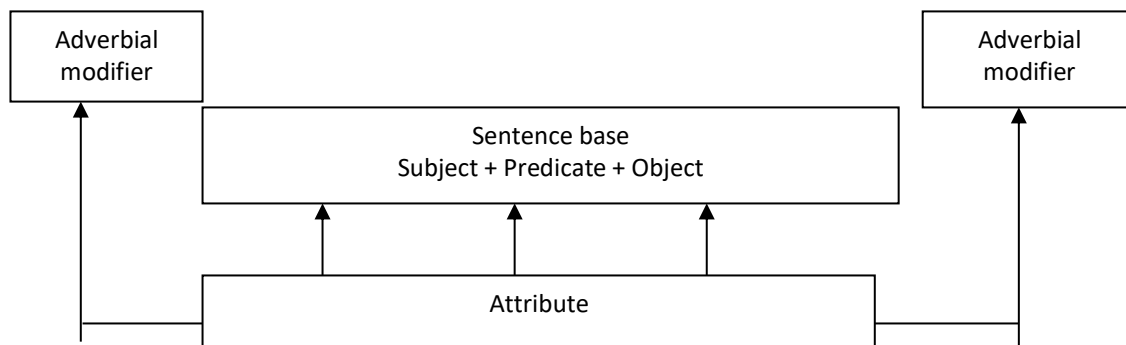
Figure 2: English sentence structure [3]

Secondary Parts of the Sentence by N. Chomsky [3, 50-58]

1. The object is a secondary sentence part, referring to some other sentence part. We distinguish a direct object (We spend *holidays* in the countryside), indirect object (He gave the pupils *a new material*), and prepositional object (They will look at *this picture*). Objects are nouns (I saw a new *film*), pronouns (I saw *it* yesterday), infinitives (I like *to read*), gerunds (I like *reading* books), or object clauses (He asks *when I shall come*).

2. The adverbial modifier (adverbial) is a secondary part sentence, which modifies another part of the sentence expressed by a verb, an adjective, or an adverb. Semantically, adverbs can denote cause (We couldn't come because *of rain*), manner (They speak English *fluently*), time (She will come *tomorrow*), place (He lives *in London*), purpose (He came *to see us*), etc., thus forming corresponding semantic classes, such as adverbial of time, place, manner, etc. Adverbial modifiers are nouns (We shall study at the *University*), adverbs (They read *fast*), participles (*Reading* the English book, he wrote out new words), infinitives (He is here *to help me*), gerunds (Before *leaving*, let me know), adverbial clause (They will phone as soon as *they finish their work*).

3. The attribute is a secondary sentence part, which qualifies a noun, a pronoun, or any other speech aspect with a nominal character. An attribute can be either in pre-position or in post-position to the word it modifies. The attribute of a noun may be a possessive noun (*Victor's* family is neither large nor small), a pronoun (*Our* school is a new one), a noun (There are many *stone* house in our city), an adjective (An *old* man sat in the garden), a numeral (They live on the *fifth* floor). There are some cases when the attribute has a post-position to a noun, an adjective, or a gerund (This method *of teaching* is very popular. We have a good teacher *of English*); infinitive (He was the first *to come*. This is a book for you *to read*); attributive clause (Give me the dictionary *you showed me the other day*); participles in pre- and post-position to the attribute (The *reported* information deals with events abroad. The article *mentioned* by our teacher was from a newspaper.).

Content analysis of the English/Ukrainian texts and identification of the stages for its further processing is an important and fundamental task. To develop a quality processing of these text data using effective syntax analysis (to specify keywords and text categories, to identify authorship, to provide adequate translation, etc.) and semantics (to highlight the content and purpose of the text) has an ultimate value in obtaining necessary information without having it overloaded with other information distractions. Modern, effective development and implementation of thematic Web

resources should be accompanied by the correct definition of many keywords, which will ensure their effective positioning and ranking in search engines databases. In addition, they should be used in the text content not randomly but in a specific order for the search engines not to index and classify them as spam. Developing a method for processing Ukrainian and English texts to find automatically significant keywords and content categories is one of the strategic directions of domestic e-business and information technologies development. It is necessary to ensure the ways of automating the stages of data processing for the identification of meaningful keywords and content categories, analysis of syntax and semantics of the text, which in its turn increases the amount of content, goods and services sales to regular users, actively attracting potential customers and expanding the target audience. In particular, these principles and technologies in e-commerce are actively used in the development of on-line/off-line sales systems and analysis/exchange/storage content, online stores, and cloud storage/computing. An absence of a general standardized approach to the Ukrainian text content processing for automatically identifying meaningful keywords and content, text syntax and semantics analysis, and functional e-commerce support systems design leads to several problems in implementing a typical structure of such systems.

4. Experiments, results and discussion

The work aims to determine the optimal method for the automatic processing textual content set of Ukrainian-language to essential keywords and content categories identification, text syntax and semantics analysis. Processing natural language corpus utterances *C* to the meaningful keywords identification is usually formed on finding keywords by content (terms) based on Zipf's law and is reduced to the choice of words with an average frequency of phrase occurrence. As a simple and easy method by N. Chomsky [50-58], we offer to apply a more complex one and carry out an appropriate experimental study. The choice of 100 scientific papers of the journal of Lviv Polytechnic National University "Series of Information Systems and Networks" (http://science.lp.edu.ua/sisn), Issue #805 (http://science.lp.edu.ua/sisn/vol-cur-805-2014-2) and Issue #783 (http://science.lp.edu.ua/SISN/SISN-2014) is chosen as the experimental basis for such research. Therefore, a new algorithm for finding a set of keywords and symbols to define internet searches considering the thematic word sets is developed. It is placed in open access at information resource on linguistics platform Victana http://victana.lviv.ua/index.php/kliuchovi-slova (Fig. 3).

I. The English terminal chain identification process, where sentences have a strictly fixed, standard word order. An affirmative sentence in English is characterized by the main syntactic categories – noun and predicate groups [1-3, 35, 59-68], which agree in number and case. The main grammatical characteristics of ат English noun group are person, degree of comparison, noun/pronoun cases, number, gender, and a verb group –person, number, voice, mood, and tense [59-68].

Noun group $\tilde{N}$ is associated with a *pronoun* P_N and has the following structural diagram (in square brackets, there are optional elements, and in curly brackets – elements, which could be repeated):

$$\tilde{N} = \tilde{N}Q\tilde{N} \text{ , or } \tilde{N} = N^p \text{ , or } \tilde{N} = [D][E][B][\{\tilde{A}\}]N[\tilde{E}], \ \tilde{E} = E\tilde{N} \tag{1}$$

where Q is the conjunction, N is a noun, A is adjective, $\tilde{A}$ is adjective group, B is an adverb, $\tilde{B}$ is adverb group, E is the preposition, $\tilde{E}$ is the prepositional group, D is a determiner.

Adjective group $\tilde{A}$ has the following structure:

$$\tilde{A} = [\{\tilde{B}\}]A[\tilde{E}], \ \tilde{B} = \{B\}[\{\tilde{E}\}]. \tag{2}$$

The structure of a *verb group* $\tilde{R}$ is:

$$\tilde{R} = R_V[\tilde{B}]. \tag{3}$$

where R_V is verb expression that consists of lexical, auxiliary and modal verb R :

$$R_V = [R_V^M][R_V^D][R_V^D][R_V^D]R_V^L, \tag{4}$$

where R_V^M is a modal verb, R_V^D is an auxiliary verb, R_V^L is the lexical verb. For modelling the syntax of an English sentence, and the structural scheme described above, we will apply the principles of the generative grammar. Its main constituents are noun group, verb group and their units (nonterminal symbols), as well as the lexis of the language (corresponding terminal characters).
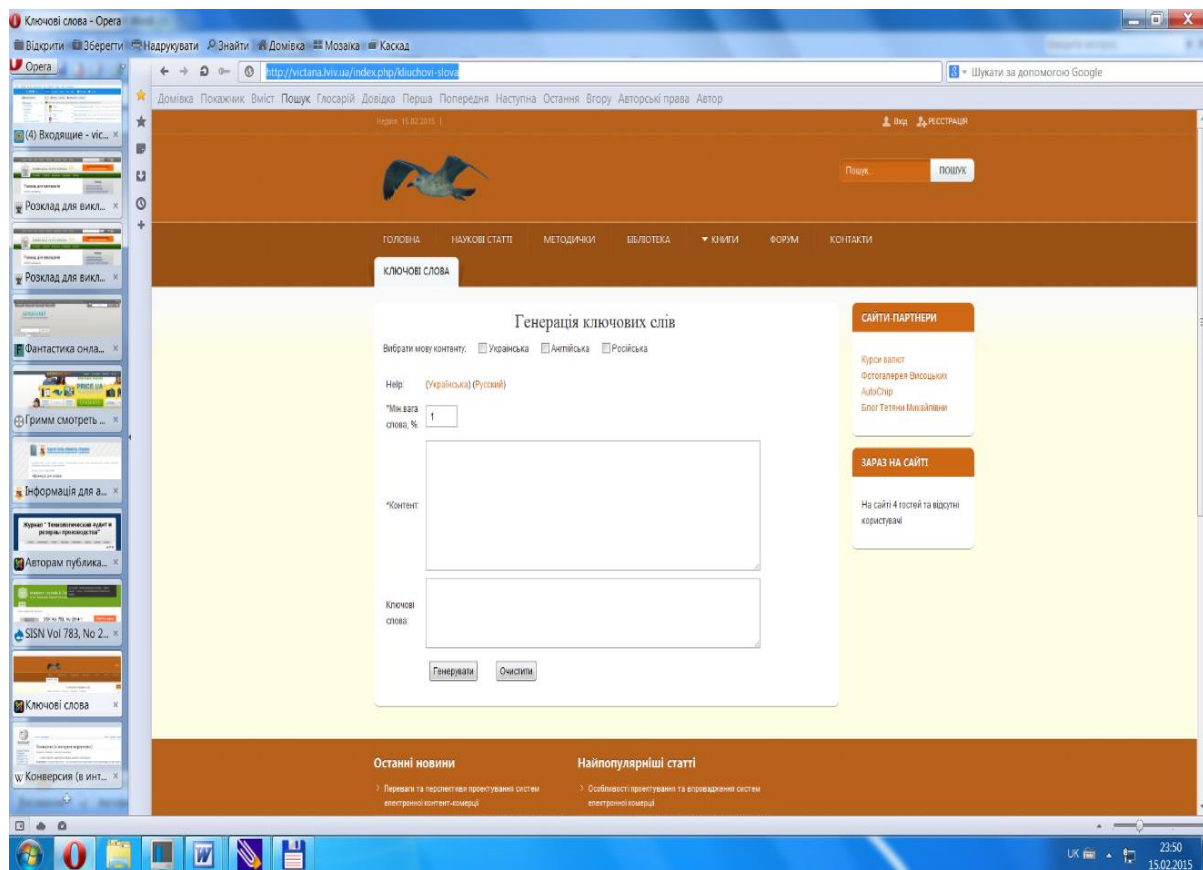
Figure 3: Web resource for analysis of syntax and semantics of English and Ukrainian texts

According to the English language rules, a noun group positions the first place, and a verb group follows it. All possible changes of terminal characters to non-terminal ones make up a set of rules. Numerous terminal chains (English sentences of the corresponding structural scheme) are received while having an output. Therefore, such grammar structures are unlimited, and due to their complexity, cannot be used. To introduce context-dependent grammar, we model the process of constructing an English simple affirmative sentence with the following restrictions on its structure:

- Noun group does not have a pronoun and a determinant article; it has a simplified adjective group and does not contain a preposition group;
- The verb group is expressed only by a lexical verb (voice – active, mood – indicative, type – simple). The adverb group does not have a prepositional group.

Let us consider the sentence of the following simplified structural scheme.

1. Simplified **noun group** $\tilde{N}$**:**

$$\tilde{N} = D\{A\}N \text{, or } \tilde{N} = N^p. \tag{5}$$

Now the main grammatical characteristics of the noun group are the number, noun case, degrees of comparison, and person. Conjunction joins adjectives.

2. The simplified **verb group** $\tilde{R}$ has the following structural scheme:

$$\tilde{R} = R_V[B]. \tag{6}$$

The main grammatical characteristics of the verb group are person, number, and tense. Adverbs can join by a conjunction, and they can be modelled by a pattern adverb+adverb [35]. In Tables 16-17, simplified noun and verb groups' components and grammatical categories are introduced (after "/" the corresponding symbol is shown). Accordingly, a reduced character of the noun group is $\tilde{N}_{NR,PR}$, and of its parts – $N_{NR,CS}$, A_{CD}; a reduced symbol of the verb group is – $\tilde{R}_{NR,PR}$, and of its parts – $R_{NR,PR,TM}$. The category of person is a grammatical category of a personal pronoun that is omitted in a simplified sentence form. However, this category must be defined for the noun group to agree on it with the verb group.

Table 16
Grammatical categories of a noun group and its components in English

Type	Meaning
Noun group/$\tilde{N}$	pronoun/ $N^{pronoun}$, noun/N, adjective/A, determiber/D,
Person/PR	first/1, second/2, third/3.
Degrees of Comparison/CD	positive degree/pd, comparative degree/cd, superlative degree/sd;
Case/CS	common case/cc, possessive case/pc;
Number/NR	singular/sg, plural/pl;

Table 17
English grammatical verb group categories and its components

Type	Meaning
Verb group/ $\tilde{R}$	verb/R, adverb/B;
Tense/TM	present/pr, past/ps, future/ft.
Person/PR	first/1, second/2, third/3;
Number/NR	singular/sg, plural/pl;

Let us consider grammar $G_1 = (S, V, T, P)$ by N. Chomsky [50-58] with symbols (to have a convenient identification of syntactic categories, we will omit indexes):

- S is the start symbol;
- $\#$ is sentence boundary symbol;
- $T = (\#, in, his, most, important, work, he, shows, the, colourful, world, of, Ukrainian, village, its, unique, charm)$;
- $V = (\tilde{N}, \tilde{R}, S, N, R, D, A, Q, E, B, \#, in, his, most, important, work, he, shows, the, colourful, world, of, Ukrainian, village, its, unique, charm)$ю

A set of rules P is presented in Table 18.

Table 18
Production rules of a terminal chain in English

No	Group	Rules
I.	Choice S	$S \rightarrow \#\tilde{N}_{NR,PR}\,\tilde{R}_{NR,PR}\,\#$, where # is the chain boundary symbol
II.	Production $\tilde{N}$	1) $\tilde{N}_{NR,PR} \rightarrow D\tilde{N}_{NR,PR}$;
		2) $\tilde{N}_{NR,PR} \rightarrow A_{CD}\tilde{N}_{NR,PR}$;
		3) $\tilde{N}_{NR,PR} \rightarrow \tilde{N}_{NR,PR}E\tilde{N}_{NR,PR}$;
		4) $\tilde{N}_{NR,PR} \rightarrow N_{NR,CS}$;
		5) $\tilde{N}_{NR,PR} \rightarrow \tilde{N}_{NR,PR}Q\tilde{N}_{NR,PR}$;
		6) $A_{CD} \rightarrow A_{CD}QA_{CD}$;
		7) $\tilde{N}_{NR,PR} \rightarrow N_{NR,CS}^{pronoun}$;
		8) $\tilde{N}_{NR,PR} \rightarrow \tilde{N}_{NR,PR}E\tilde{N}_{NR',PR'}$;
		9) $A_{CD} \rightarrow BA_{CD}$;
		10) $A_{CD} \rightarrow B^{degree}A_{CD}$;
		11) $\tilde{N}_{NR,PR} \rightarrow N_{NR,CS}EN_{NR',CS}$;
		12) $\tilde{N}_{NR,PR} \rightarrow E\tilde{N}_{NR,PR}\tilde{N}_{NR,PR}$.
III.	Production $\tilde{R}$	1) $\tilde{R}_{NR,PR} \rightarrow R_{NR,PR,TM}$;
		2) $\tilde{R}_{NR,PR} \rightarrow R_{NR,PR,TM}B$;
		3) $B \rightarrow BQB$;

	4) $B \rightarrow BB$;
	5) $\tilde{R}_{NR,PR} \rightarrow \tilde{R}_{NR,PR}\tilde{N}_{NR,PR}$;
	6) $BB \rightarrow B^{degree}B$, it means that compatibility of the adverb is context dependant. The meaning of the restriction is that the adverbs of quantity and degree in combination with another adverb mainly function as a pre-position element (*most important, so well, almost far*) [34].
	1) $A_{CD} \rightarrow Ukrainian_{CD}$ (*український* [ukrainskyi]);
	2) $A_{CD} \rightarrow important_{CD}$ (*важливий* [vazhlyvyi]);
	3) $A_{CD} \rightarrow colourful_{CD}$ (*барвистий* [barvystyi]);
	4) $A_{CD} \rightarrow unique_{CD}$ (*неповторний* [nepovtornyi]);
	5) $N_{NR,CS} \rightarrow work_{NR,CS}$ (*робота* [robota]);
	6) $N_{NR,CS} \rightarrow world_{NR,CS}$ (*світ* [svit]);
	7) $N_{NR,CS} \rightarrow village_{NR,CS}$ (*село* [selo]);
	8) $N_{NR,CS} \rightarrow charm_{NR,CS}$ (*привабливість* [pryvablyvist]);
	9) $D \rightarrow the$ (*означений артикль* [definite article]);
IV. Presentation of categories	10) $R_{NR,PR,TM} \rightarrow show_{NR,PR,TM}$ (*показувати* [pokazuvaty]);
	11) $B^{degree} \rightarrow most$ (*найбільш* [naibilsh]);
	12) $Q \rightarrow and$ (*і* [e]);
	13) $B \rightarrow important$ (*важливо* [vazhlyvo]);
	14) $N_{NR,CS}^{pronoun} \rightarrow he_{NR,CS}$ (*він* [vin]);
	15) $E \rightarrow in$ (*в* [v]);
	16) $E \rightarrow of$ (*для* [dlia]);
	17) $N_{NR,CS}^{pronoun} \rightarrow it_{NR,CS}$ (*вона* [vona]);
	18) $N_{NR,CS}^{pronoun} \rightarrow it_{NR,CS}$ (*воно* [vono]);
	19) $A_{CD} \rightarrow its_{CD}$ (*свій* [sviy]);
	20) $A_{CD} \rightarrow his_{CD}$ (*свій* [sviy]).

II. The Ukrainian terminal chain identification process [7, 10, 32-33, 36, 38-49]. The sentence is characterized by a loose word though a standard word order is also peculiar for some linguistic elements [19-20]. The structural scheme is fixed for a simple sentence with direct word order, and the principal such sentence syntactic categories are noun and verb groups [69-83]. Enumerable grammar, built on the same principles as in the previous examples, cannot be applied due to its complexity. To develop context-dependent grammar, we introduce certain restrictions, first, on the sentence level. Considering the Ukrainian sentence structure with direct word order (for example, the adjective has a preposition to the noun or the noun group elements are formed around the noun, etc.) [84-86], we will examine **a noun group** $\tilde{N}$ of the following structural scheme:

$$\tilde{N} = N^p \text{ or } \tilde{N} = \{AN\}. \tag{7}$$

The adjective and the noun in the noun group agree in case, number and gender [7, 19, 87-99].

The **verb group** $\tilde{R}$ of such a structural scheme is:

$$\tilde{R} = R\tilde{N} \text{ or } \tilde{R} = \tilde{N}R. \tag{10}$$

The Ukrainian noun and verb group agree in number, gender and person (Tables 19-20) [100-101].

Table 19

Grammatical categories of a noun group and its components in Ukrainian

Type	Meaning
Imenna hrupa(Noun group)/$\tilde{N}$	zaimennyk (pronoun)/ $N^{займ}$, imennyk (noun)/N, prykmetnyk (adjective)/A,

Rid (Gender)/*РД*	cholovichyi (masculine)/*ч*, zhinochyi (feminine)/*ж*, serednii (neutral)/*с*;
Chyslo(Number)/*ЧЛ*	odnyna (singular)/*од*, mnozhyna (plural)/*мн*;
Vidminok (Case)/*ВД*	nazyvnyi (nominative)/*н*, rodovyi (genitive)/*р*, davalnyi (dative)/*д*, znakhidnyi (accusative)/*з*, orudnyi (ablative)/*о*, mistsevyi (locative)/*м*, klychnyi (vocative)/*к*;
Osoba (Person)/*OC*	first-person/*1*, second-person/*2*, third-person/*3*.

Table 20

Grammatical categories of a verb group and its components in Ukrainian

Type	Meaning
Diyeslivna hrupa (verb group)/ $\tilde{R}$	diyeslovo (verb)/*R*, v mezhakh imennoi hrupy prykmetnyk (an adjective within a noun group)/*A*, imennyk (noun)/*N*;
Chyslo (Number)/*ЧЛ*	odnyna (singular)/*од*, mnozhyna (plural)/*мн*;
Rid (Gender)/*РД*	cholovichyi (masculine)/*ч*, zhinochyi (feminine)/*ж*, serednii (neutral)/*с*;
Osoba (Person)/*OC*	first-person/*1*, second-person/*2*, third-person/*3*.
Chas (Tense)/*ЧС*	maibutniy (future)/*мб*, mynulyi (past)/*мн*, tepereshniy (present)/*тп*.

Let us consider grammar $G_2 = (S, V, T, P)$ by N. Chomsky [50-58] with symbols (to have a convenient identification of syntactic categories, we will omit indexes):

- S is start symbol;
- $\#$ is sentence boundary symbol;
- $V = (\tilde{N}, \tilde{R}, N, N^{pron}, R, S, A, E, \#, u, svii, naibilsh, vazhlyvyi, robota, vin, pokazuvaty, barvystyi, svit, ukrainskyi, selo, v, nepovtornyi, pryvablyvist)$;
- $T = (\#, u, svii, naibilsh, vazhlyvyi, robota, vin, pokazuvaty, barvystyi, svit, ukrainskyi, selo, v, nepovtornyi, pryvablyvist)$;
- Rule IV does not include agreement A with an alive subject S in the accusative case.
  A set of rules P is presented in Table 21.

Table 21

Production rules of a terminal chain in Ukrainian

No	Group	Rules
I.	S	$S \to \# \tilde{N}_{РД,ЧЛ,н,OC} \ \tilde{R}_{ЧЛ,mn,OC} \#$.
		1) $\tilde{N}_{РД,ЧЛ,ВД,3} \to A_{РД,ЧЛ,ВД} \ \tilde{N}_{РД,ЧЛ,ВД,3}$;
		2) $\tilde{N}_{РД,ЧЛ,ВД,3} \to \tilde{N}_{РД,ЧЛ,ВД,3} \ \tilde{N}_{РД',ЧЛ',р,OC}$;
		3) $\tilde{N}_{РД,ЧЛ,ВД,3} \to \tilde{N}_{РД,ЧЛ,ВД,3} \tilde{N}_{РД,ЧЛ,м,3}$;
		4) $\tilde{N}_{РД,ЧЛ,ВД,3} \to E\tilde{N}_{РД,ЧЛ,ВД,3}$;
II.	$\tilde{N}$	5) $\tilde{N}_{РД,ЧЛ,ВД,3} \to N_{РД,ЧЛ,ВД}$;
		6) $K_1 \tilde{N}_{РД,ЧЛ,ВД,OC} K_2 \to K_1 N^{займ}_{РД,ЧЛ,ВД,OC} K_2$, where K_1 is a symbol other than the symbol $A_{РД,ЧЛ,ВД}$, and K_2 – a symbol other than the index symbol $ВД' = p$. Symbols K_1 and K_2 have contextual limits. The meaning of their introduction is that a personal pronoun should not realize the primary member of the nominal group if it precedes an attribute expressed by an adjective. Or if a noun group in the genitive case follows it (to avoid ambiguous phrases such as *prykordonnyi vin* or *my shvydkosti*).
		1) $\tilde{R}_{ЧЛ,mn,OC} \to E\tilde{N}_{РД,ЧЛ,м,3} R_{ЧЛ,mn,OC}$;
		2) $\tilde{R}_{ЧЛ,mn,OC} \to R_{ЧЛ,mn,OC} E\tilde{N}_{РД,ЧЛ,м,3}$
III.	$\tilde{R}$	3) $\tilde{R}_{ЧЛ,mn,OC} \to R_{ЧЛ,mn,OC} \ \tilde{N}_{РД',ЧЛ',о,OC'}$.
		4) $\tilde{R}_{ЧЛ,mn,OC} \to R_{ЧЛ,mn,OC} \ \tilde{N}_{РД',ЧЛ',з,OC'}$;
		5) $\tilde{R}_{ЧЛ,mn,OC} \to R_{ЧЛ,mn,OC} \ \tilde{N}_{РД',ЧЛС,о,OC'} \ \tilde{N}_{РД'',ЧЛ'',з,OC''}$;

6) $\tilde{R}_{ЧЛ,mn,ОС} \rightarrow R_{ЧЛ,mn,ОС} \; \tilde{N}_{РД',ЧЛ',з,ОС'} \; \tilde{N}_{РД'',ЧЛ'',о,ОС''}$.

1) $N_{ж,ЧЛ,ВД} \rightarrow робота_{ЧЛ,ВД}, привабливість_{ЧЛ,ВД}, \ldots$, where *work - робота* [robota], *charm - привабливість* [pryvablyvist];

2) $N_{ч,ЧЛ,ВД} \rightarrow світ_{ЧЛ,ВД}, \ldots$, where *world - світ* [svit];

3) $N_{с,ЧЛ,ВД} \rightarrow село_{ЧЛ,ВД}, \ldots$, where *village - село* [selo];

4) $N_{РД,од,ВД,1}^{займ} \rightarrow він_{ВД}$, where *he - він* [vin];

IV. words

5) $A_{РД,ЧЛ,ВД} \rightarrow український_{РД,ЧЛ,ВД}, найбільший_{РД,ЧЛ,ВД}, неповторний_{РД,ЧЛ,ВД}, \ldots$, where *Ukrainian - український* [ukrainskyi], *most - найбільший* [naibilshyy], *unique - неповторний* [nepovtornyi];

6) $A_{РД,ЧЛ,ВД} \rightarrow свій_{РД,ЧЛ,ВД}, важливий_{РД,ЧЛ,ВД}, барвистий_{РД,ЧЛ,ВД}, \ldots$, where *its - свій* [sviy], *important - важливий* [vazhlyvyi], *colourful - барвистий* [barvystyi];

7) $E \rightarrow в, у, \ldots$, where *in - в* [v], *у* [u];

8) $R_{ЧЛ,mn,ОС} \rightarrow показувати_{ЧЛ,mn,ОС}, \ldots$, *where* show *- показувати* [pokazuvaty].

These rules can be used for systems development of keyword identification, text rubrication, machine translation, error correction [102-111], also for human psychological analysis, semantic analysis, etc. [112-131]. In Figure 4, a keyword table is shown where the attribute *rub_id* describes the rubric to which a particular keyword belongs in a given entry (Table 22).
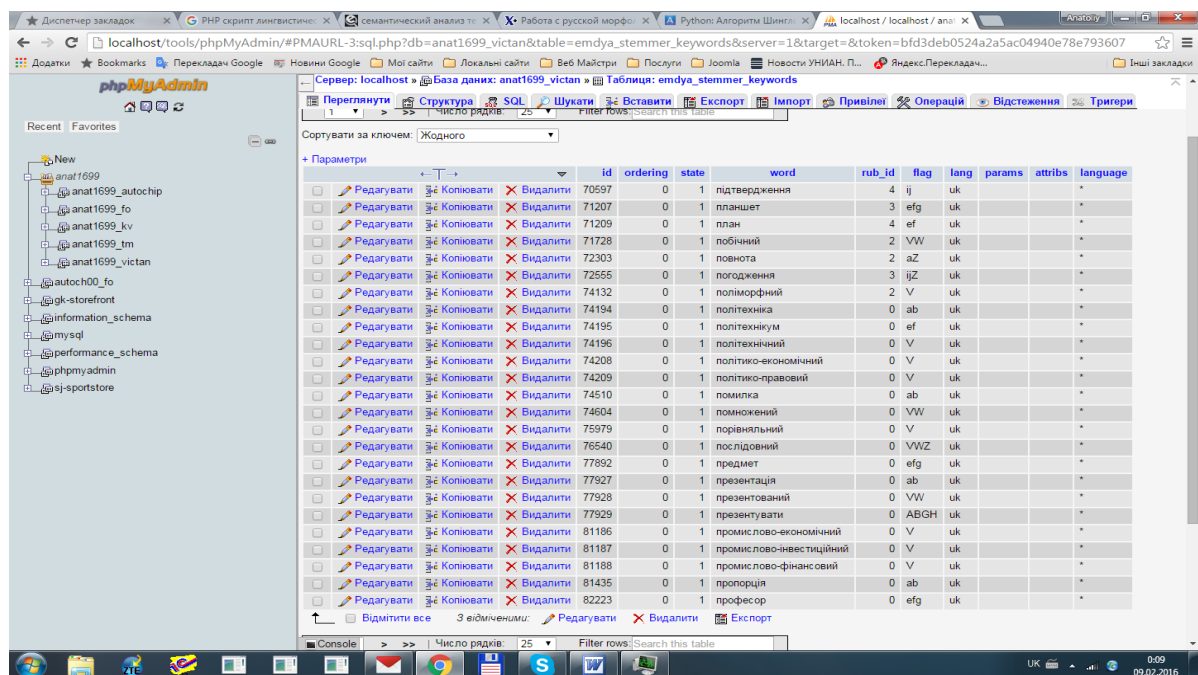
Figure 4: Table of keywords

Table 22

Ukrainian and English words/flag example for keywords identification

Ukrainian Word/flag [Transliteration]	Translation and English Word/flag
буферизувати/ABGH [buferyzuvaty/ABGH]	buffer/18,9,13,17,10,23
відформатувати/AB [vidformatuvaty/AB]	format/1,20,17
кодувати/ABGH [koduvaty/ABGH]	code/17,2,23,10,12,18,9
кешувати/ABGH [keshuvaty/ABGH]	cache/9,17,18,10,13
кирилічний/V [kyrylichnyi/V]	Cyrillic
кілобайтовий/V [kilobaitovyi/V]	kilobyte/17
кілобайт/efg [kilobait/efg]	
кілобітовий/V [kilobitovyi/V]	kilobit/17

кілобіт/efg [kilobit/efg]	
кілобод/efg [kilobod/efg]	kilobaud/13
клавіатурний/V [klaviaturnyi/V]	keyboard/18,9,13,23,10,17
клавіатура/ab [klaviatura/ab]	
Кобол/e [Kobol/e]	COBOL
	Cobol/13
кодек/efg [kodek/efg]	coder/2,13
кодер/efg [koder/efg]	
кука/ab [kuka/ab]	hook/10,23,9,18,13,17
крос-компілятор/efg [kros-kompiliator/efg]	cross/13
	compilable/7
	compilation/17,1,13
	compile/1,17,9,2,10
	compiler/2,17
	compiler's
крос-асемблер/efg [kros-asembler/efg]	cross-assembler/3,13,17
криптозахищений/V [kryptozakhyshchenyi/V]	crypto-protected/7,21
криптографічний/V [kryptohrafichnyi/V]	cryptographic
	cryptographically
	cryptography/13,17
копірайт/e [kopirait/e]	copyright/13,17,18,9,10,23
копілефт/e [kopileft/e]	Copyleft/19,18,17
конфігуратор/efg [konfihurator/efg]	configuration/1,17,13
	configure/1,10,17,9,8
консоль/ij [konsol'/ij]	console/23,8,10
консольний/V [konsolnyi/V]	consoled/7
	consoler/13
конкатенація/ab [konkatenatsiia/ab]	concatenate/22,17,9,10
комутований/V [komutovanyi/V]	switch/10,8,23,13,18,17,9,12
комбосписок/ab [kombospysok/ab]	combo/13,17
	box/9,18,17,12,23,10,13
	list/12,13,18,9,15,10,23,22,17
кодосумісний/V [kodosumisnyi/V]	code/17,2,23,10,12,18,9
	code compatible
	compatible/17,5
	compatibleness/13
	compatibility/5,13,17
	compatibly/5
кодогенератор/efg [kodohenerator/efg]	code/17,2,23,10,12,18,9
	generators/1
	generator/17,13
курсорний/V [kursornyi/V]	cursoriness/17,13
	cursorily
	cursor/9,13,17,10
	cursory/16

The attribute *flag* specifies the properties of this keyword (the language part it belongs to). In thematic dictionaries, each word has its property, for example, it is shown in Table 22, where groups *a b c d o* describe some nouns for Ukrainian words, A is a verb, and V is an adjective, (Figure 5). In thematic dictionaries, each word has its characteristics, for example, it is shown in Table 22, where numbers 1-23 are numbers of PFX type rules (prefixes, 1-7 rules) and SFX (suffixes and endings, 8-23 rules) and describe some nouns for English words (Fig. 4). For example, the PFX type rules describe as some nouns modification for English words with prefixes: re-(rule PFX 1), de- (rule PFX 2), dis- (rule PFX 3), con- (rule PFX 4), in- (rule PFX 5), pro- (rule PFX 6) and un- (rule PFX 7). The SFX type rules describe some nouns modification for English words with suffixes or endings:

- *-able* [^aeiou], *-able* ee, *-able* [^aeiou]e (rule SFX 8),
- *-d* e, *-ied* [^aeiou]y, -ed [^ey], *-ed* [aeiou]y (rule SFX 9),
- *-ing* e, *-ing* [^e] (rule SFX 10),
- *- ieth* y, *-th* [^y] (rule SFX 11),
- *-ings* e, *-ings* [^e] (rule SFX 12),
- -'*s* (rule SFX 13),
- *-ment* (rule SFX 14),
- *-ion* e, *-ication* y, *-en* [^ey] (rule SFX 15),
- *-iness* [^aeiou]y, *-ness* [aeiou]y, *-ness* [^y] (rule SFX 16),
- *-ies* [^aeiou]y, *-s* [aeiou]y, *-es* [sxzh], *-s* [^sxzhy] (rule SFX 17),
- *-r* e, *-ier* [^aeiou]y, *-er* [aeiou]y, *-er* [^ey] (rule SFX 18),
- *-st* e, *-iest* [^aeiou]y, *-est* [aeiou]y, *est* [^ey] (rule SFX 19),
- *-ive* e, *-ive* [^e] (rule SFX 20),
- -ly (rule SFX 21),
- *-ions* e, *-ications* y, *-ens* [^ey] (rule SFX 22),
- *-rs* e, *-iers* [^aeiou]y, *-ers* [aeiou]y, *-ers* [^ey] (rule SFX 23).

The letters *e* and *y* near the suffixes are markers of solutions.


```
Файл  Правка  Вид  Справка
###########################################################
# Групи a b c d o
#
# -- Перша відміна: іменники жіночого та чоловічого та середнього роду
#
# -- Друга відміна: іменники чоловічого роду із закінченням на -ар -ир
#                   наголошені (Мішана група на -ар -ир)
#
# -- Друга відміна: іменники чоловічого роду з чергуванням -і -о
#
# -- Числівники -ять, -сят, -сто
#
#

SFX a Y 235

#
# ОДНИНА (множина перенесена в гр. b)
#
# Спочатку перша відміна
#
# тверда група в Називному відмінку однини з закінченням на -а
# однина
SFX a   а и [^жчшщ]а  # хата  хати  (Р.)
SFX a   а і [^ггкх]а  # хата  хаті  (Д.М.)
SFX a   а у а    # хата  хату  (З.)
SFX a   а ою [^жчшщ]а  # хата  хатою  (О.)
```
Figure 5: Dictionary of nouns for Ukrainian words

The affix file usually has a * .aff extension and may contain optional attributes. For example, SET to determine the type of a character encoding in affix and dictionary files. TRY specifies the characters to replace English words. REP defines a substitution table to correct multiple characters for English words. PFX and SFX define classes of prefixes and suffixes that are labelled with affixes for English words (https://gist.github.com/tararoys/76417eda6af9e331b587).

In Figure 7, the table of rules of reduction to a word basis is presented. The attribute *flag* defines the word type (here, it is a noun group, singular). An attribute *mask* shows the rule of ending identification, an attribute *find* – the word ending in a nominative case, an attribute *repl* – the term ending when declining. In square brackets exceptions to the rules are given.

```
TRY esianrtolcdugmphbyfvkwzESIANRTOLCDUGMPHBYFVKWZ'оаитенрсвйлпкьыяудмзшбчгщюжцёхфзъАВСМКГПТЕИЛФНДОЭРЗЮЯБХЖШЦУЧЬЫЪЩЙЁ

FLAG num

NOSUGGEST 49
ONLYINCOMPOUND 50

COMPOUNDMIN 1

REP 88
REP a ei
REP ei a
REP a ey
REP ey a
REP ai ie
REP ie ai
REP are air
REP are ear
REP are eir
REP air are
REP air ere
REP ere air
REP ere ear
REP ere eir
REP ear are
REP ear air
REP ear ere
REP eir are
REP eir ere
REP ch te
REP te ch
REP ch ti
REP ti ch
REP ch tu
REP tu ch
REP ch s
REP s ch
REP ch k
```

```
REP ear air
REP air ear
REP w qu
REP qu w
REP z ss
REP ss z
REP shun tion
REP shun sion
REP shun cion

PFX 1 Y 1
PFX 1 0 re .

PFX 2 Y 1
PFX 2 0 de .

PFX 3 Y 1
PFX 3 0 dis .

PFX 4 Y 1
PFX 4 0 con .

PFX 5 Y 1
PFX 5 0 in .

PFX 6 Y 1
PFX 6 0 pro .

PFX 7 Y 1
PFX 7 0 un .

SFX 8 Y 3
SFX 8 0 able [^aeiou]
SFX 8 0 able ee
SFX 8 e able [^aeiou]e

SFX 9 Y 4
SFX 9 0 d e
```

```
SFX 16 0 ness [^y]

SFX 17 Y 4
SFX 17 y ies [^aeiou]y
SFX 17 0 s [aeiou]y
SFX 17 0 es [sxzh]
SFX 17 0 s [^sxzhy]

SFX 18 Y 4
SFX 18 0 r e
SFX 18 y ier [^aeiou]y
SFX 18 0 er [aeiou]y
SFX 18 0 er [^ey]

SFX 19 N 4
SFX 19 0 st e
SFX 19 y iest [^aeiou]y
SFX 19 0 est [aeiou]y
SFX 19 0 est [^ey]

SFX 20 N 2
SFX 20 e ive e
SFX 20 0 ive [^e]

SFX 21 Y 1
SFX 21 0 ly .

SFX 22 Y 3
SFX 22 e ions e
SFX 22 y ications y
SFX 22 0 ens [^ey]

SFX 23 Y 4
SFX 23 0 rs e
SFX 23 y iers [^aeiou]y
SFX 23 0 ers [aeiou]y
SFX 23 0 ers [^ey]
```

```
SFX 9 Y 4
SFX 9 0 d e
SFX 9 y ied [^aeiou]y
SFX 9 0 ed [^ey]
SFX 9 0 ed [aeiou]y

SFX 10 Y 2
SFX 10 e ing e
SFX 10 0 ing [^e]

SFX 11 N 2
SFX 11 y ieth y
SFX 11 0 th [^y]

SFX 12 Y 2
SFX 12 e ings e
SFX 12 0 ings [^e]

SFX 13 Y 1
SFX 13 0 's .

SFX 14 Y 1
SFX 14 0 ment .

SFX 15 Y 3
SFX 15 e ion e
SFX 15 y ication y
SFX 15 0 en [^ey]

SFX 16 Y 3
SFX 16 y iness [^aeiou]y
SFX 16 0 ness [aeiou]y
SFX 16 0 ness [^y]

SFX 17 Y 4
SFX 17 y ies [^aeiou]y
SFX 17 0 s [aeiou]y
SFX 17 0 es [sxzh]
```

Figure 6: Dictionary of nouns for English words
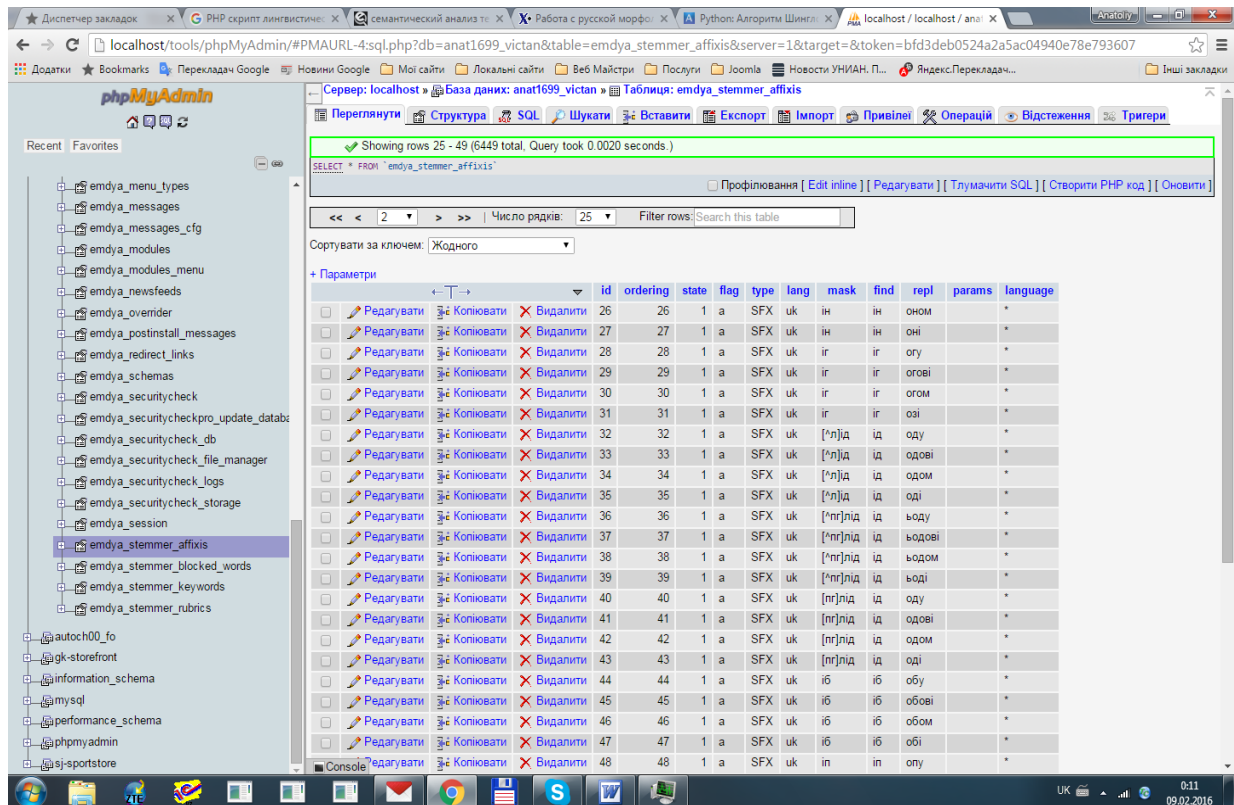
Figure 7: Rules of reduction to the word basis

The first line describes a specific example of the Ukrainian nouns ending in *-in* alternate with *-i -o*:

```
SFX a  in   onu     in              # zahin  zahonu      (Д. (Dative case), P. (Genetive case))
SFX a  in   onovi   in              # zahin  zahonovi    (Д.)
SFX a  in   onom    in              # zahin  zahonom     (O.)
SFX a  in   oni     in              # zahin  zahoni      (M. (Locative case))
```

The third line describes a specific example of the Ukrainian nouns ending in *-ih* alternate with *-i -o*:

```
SFX a  ih   ohu     ih              # batih  batohu      (Д. (Dative case), P. (Genetive case))
SFX a  ih   ohovi   ih              # batih  batohovi    (Д.М.)
SFX a  ih   ohom    ih              # batih  batohom     (O.)
SFX a  ih   ozi     ih              # batih  batozi      (M. (Locative case))
```

The ninth line describes a specific example of Ukrainian nouns ending in *-id* alternate with *-i -o*:

```
SFX a  id   odu     [^l]id          # provid  provodu    (Д. (Dative case), P. (Genetive case))
SFX a  id   odovi   [^l]id          # provid  provodovi  (Д. (Dative case))
SFX a  id   odom    [^l]id          # provid  provodom   (O. (Ablative case))
SFX a  id   odi     [^l]id          # provid  provodi    (M.)
```

REP defines a substitution table to correct multiple characters for Ukrainian words, for example:

```
REP 5
REP сч щ
REP уюч увальн
REP ююч ювальн
REP ємн місtк
REP обез зне
```

A table of blocked words by a moderator, i.e., words that cannot be keywords, is shown in Figure 8. A table of rubrics is demonstrated in Fig. 9. An example of rules of morphological analysis of Ukrainian adjectives is shown in Figure 10. Negative form prefix:

- Adjectives ending in *–ий;*
- Adjectives of the short form in *-ен* change in the same way as to complete (*ясен - ясний...*) in masculine gender
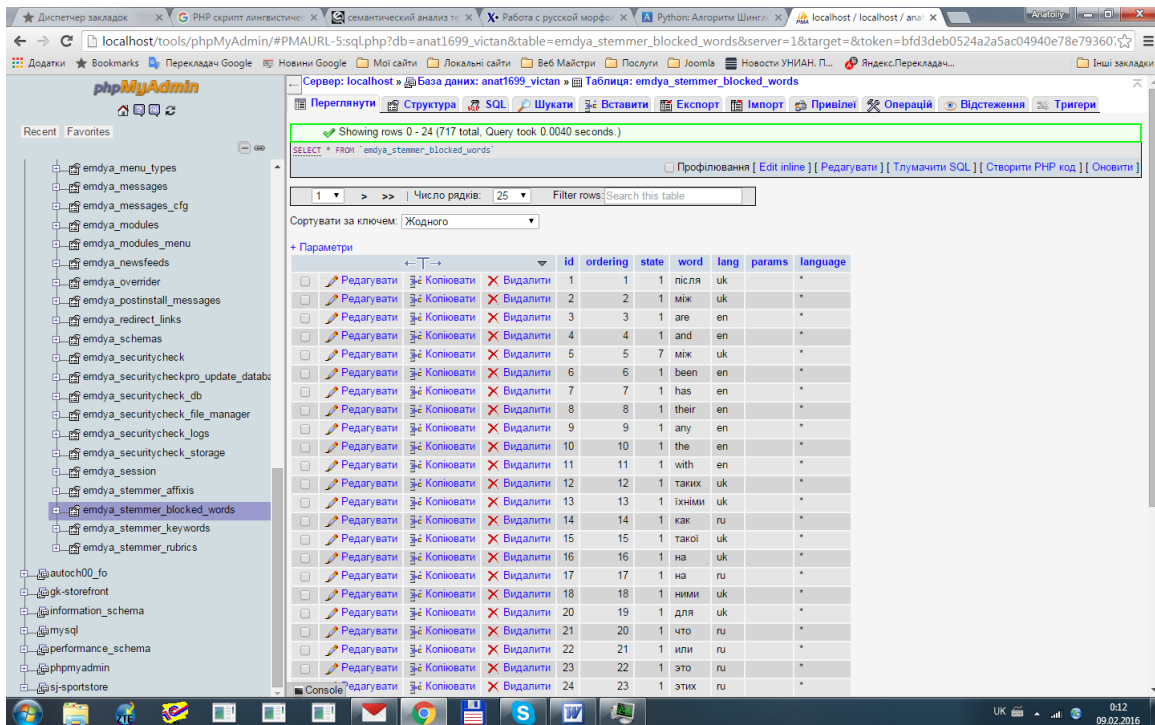
Figure 8: A table of blocked words
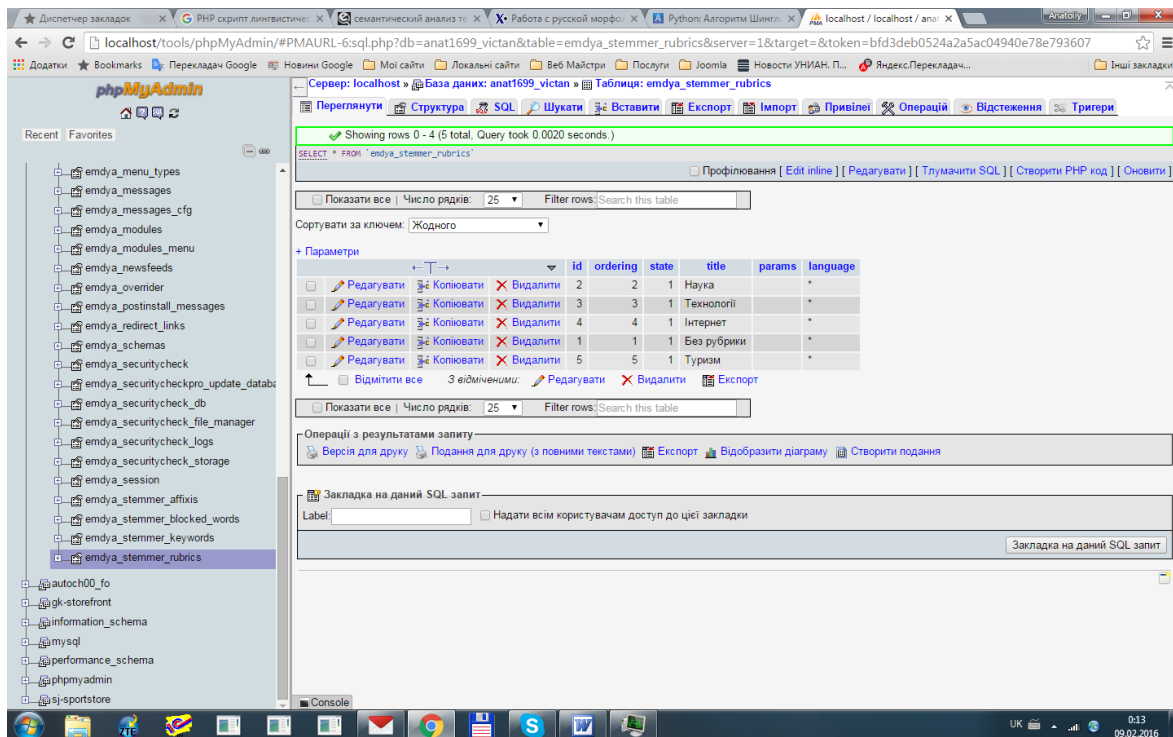
Figure 9: A table of rubrics

PFX Z Y 1

PFX Z 0 не. #voice> mute

You cannot use /Y with the /Z flag. The original root of the group /Y are adjectives in comparative degree (*не простий*/Y, but *простіший*/Y):

PFX Y Y 1

PFX Y 0 най. # голосніший > найголосніший

Identical words with the prefix *в-* formed out of talks with the prefix *у-* can create too long lines of word forms, not yet used:

PFX X Y 1
PFX X в у в # вбити > убити

```
# ------------------------------------------------------------
# Прикметники: V W
# ------------------------------------------------------------


SFX V Y 83

#
# Прикметники із закінченням на -ий
# прикметники короткої форми на -ен змінюються так само як і повної (ясен - ясний...)
#
# Чоловічого роду
SFX V    ий    ого    [^ц]ий        # відісланий  відісланого   (Р.З.)
SFX V    ий    ому    [^ц]ий        # відісланий  відісланому   (Д.М.)
SFX V    ий    им     ий            # відісланий  відісланим    (О. Мн:Д.)
SFX V    ий    ім     ий            # відісланий  відіслонім    (М.)
# Жіночого роду
SFX V    ий    а      [^ц]ий        # відісланий  відіслана     (Н.)
SFX V    ий    ої     [^ц]ий        # відісланий  відісланої    (Р.)
SFX V    ий    ій     ий            # відісланий  відісланій    (Д.)
SFX V    ий    у      [^ц]ий        # відісланий  відіслану     (З.)
SFX V    ий    ою     [^ц]ий        # відісланий  відісланою    (О.)
# Середнього роду
SFX V    ий    е      ий            # відісланий  відіслане     (Н.)
# Множина
SFX V    ий    і      ий            # відісланий  відіслані     (Н.)
SFX V    ий    их     ий            # відісланий  відісланих    (Р.)
SFX V    ий    ими    ий            # відісланий  відісланими   (О.)
#
# Прикметники на -лиций
#
# Чоловічого роду
SFX V    ий    ього   [^у]ций       # білолиций  білолицього   (Р.З.)
SFX V    ий    ьому   [^у]ций       # білолиций  білолицьому   (Д.М.)
# Жіночого роду
SFX V    ий    я      [^у]ций       # білолиций  білолиця  (Н.)
SFX V    ий    ьої    [^у]ций       # білолиций  білолицьої    (Р.)
SFX V    ий    ю      [^у]ций       # білолиций  білолицю  (З.)
SFX V    ий    ьою    [^у]ций       # білолиций  білолицьою    (О.)
#
# Чоловічого роду
SFX V    ий    ого    уций          # куций  куцого       (Р.З.)
SFX V    ий    ому    уций          # куций  куцому       (Д.М.)
# Жіночого роду
SFX V    ий    а      уций          # куций  куца  (Н.)
SFX V    ий    ої     уций          # куций  куцої        (Р.)
SFX V    ий    у      уций          # куций  куцу  (З.)
SFX V    ий    ою     уций          # куций  куцою        (О.)
#
# Прикметники із закінченням на -ій/-їй
#
# Чоловічого роду
SFX V    ій    ього   ій            # синій  синього      (Р.)
```

Figure 10: Example of rules of morphological analysis of Ukrainian adjectives

Fig. 11 shows an example of rules of morphological analysis of Ukrainian verbs.

```
SFX A Y 402

# зворотня форма - в групі /B
# складний майбутній час = /AG та складний зворотній час зворотньої форми = /BH
#
# МН (окрім Я, Ти, Він) для всіх закінчень, крім "йти" (йшов, йшла, йшло), та -сти
SFX A    ти      ла      [^с]ти         # абонувати  абонувала     (Вона)
SFX A    ти      ло      [^с]ти         # абонувати  абонувало     (Воно)
SFX A    ти      ли      [^с]ти         # абонувати  абонували (Ми, Ви, Вони)
SFX A    ти      в       [аеиіїоуя]ти        # абонувати  абонував  (Я, Ти, Він)

# Т -вати (Т недоконаної форми, МБ доконаної)
SFX A    вати    ю       [ауюя]вати          # абонувати  абоную          (Я)
SFX A    вати    єш      [ауюя]вати          # абонувати  абонуєш         (Ти)
SFX A    вати    є       [ауюя]вати          # абонувати  абонує          (Він)
SFX A    вати    ємо     [ауюя]вати          # абонувати  абонуємо  (Ми)
SFX A    вати    єте     [ауюя]вати          # абонувати  абонуєте        (Ви)
SFX A    вати    ють     [ауюя]вати          # абонувати  абонують        (Вони)
# МН -ати
# НФ -вати
SFX A    вати    й       [ую]вати            # абонувати  абонуй          (Ти)
SFX A    вати    ймо     [ую]вати            # абонувати  абонуймо  (Ми)
SFX A    вати    йте     [ую]вати            # абонувати  абонуйте  (Ви)
SFX A    ти      й       [ая]вати            # ставати  ставай          (Ти)
SFX A    ти      ймо     [ая]вати            # ставати  ставаймо  (Ми)
SFX A    ти      йте     [ая]вати            # ставати  ставайте        (Ви)
# Т -рвати, -звати (Т недоконаної форми, МБ доконаної)
SFX A    ати     у       [рз]вати         # рвати  рву                (Я)
SFX A    ати     еш      [рз]вати         # рвати  рвеш        (Ти)
SFX A    ати     е       [рз]вати         # рвати  рве         (Він)
SFX A    ати     емо     [рз]вати         # рвати  рвемо       (Ми)
SFX A    ати     ете     [рз]вати         # рвати  рвете       (Ви)
SFX A    ати     уть     [рз]вати         # рвати  рвуть       (Вони)
# НФ -вати
SFX A    ати     и       [рз]вати         # рвати  рви         (Ти)
SFX A    ати     імо     [рз]вати         # рвати  рвімо       (Ми)
SFX A    ати     іть     [рз]вати         # рвати  рвіть       (Ви)
#
# Дієслова з закінченням -зати з чергуванням з/ж (без чергування - гр. /I)
# Т -зати (Т недоконаної форми, МБ доконаної)
SFX A    зати    жу      зати        # казати  кажу        (Я)
SFX A    зати    жеш     зати        # казати  кажеш       (Ти)
SFX A    зати    же      зати        # казати  каже        (Він)
SFX A    зати    жемо    зати        # казати  кажемо      (Ми)
SFX A    зати    жете    зати        # казати  кажете      (Ви)
SFX A    зати    жуть    зати        # казати  кажуть      (Вони)
# МН -зати
# НФ -зати
# варіанти закінчень: -жи (д.ф. зв'яжи), -ж (різати, зарізати - ріж), і в гр. /I -зай (вирізати - вирізай)
SFX A    зати    ж       ізати       # різати  ріж         (Ти)
SFX A    зати    ж       мазати      # мазати  маж         (Ти)
SFX A    зати    жи      казати      # казати  кажи            (Ти)
SFX A    зати    жи      [еия]зати        # лизати  лижи           (Ти)
```

Figure 11: Example of rules of morphological analysis of Ukrainian verbs

Figure 12, it is presented an example of rules of morphological analysis for Ukrainian nouns.

```
# тверда група в Називному відмінку однини з закінченням на -а
# Множина
SFX b    а      0     [^клн]а          # хата   хат                    (Р.)
#        [^ВКЛНРШЧ] А    >         -А,-        # хата > хат                (Р.)
#        [ШЧ] А         >         -А,ЕЙ      # миша > мишей              (Р.)
SFX b    а      0     [^ст]ла          # щогла   щогл                   (Р.)
SFX b    ла     ел    [ст]ла           # мітла   мітел                  (Р.)
#        [^К] В А       >         -А,-        # глава > глав              (Р.)
#        [^Р] К В А     >         -А,-        # буква > букв              (Р.)
#        Р К В А        >         -ВА,ОВ      # церква > церков           (Р.)
SFX b    а      0     [^сжзвм]на       # батьківщина  батьківщин       (Р.)
SFX b    на     ен    [сжвм]на         # сосна  сосен                   (Р.)
SFX b    на     н     изна             # тризна  тризн                  (Р.)
SFX b    на     ен    озна             # борозна  борозен               (Р.)
SFX b    а      0     [аеєоуиіїяю]ка     # автоматика  автоматик (Р.)
SFX b    ка     ок    [^аеєоуиіїяю]ка    # відпустка  відпусток         (Р.)
# МР 2002.01.25
#        Ш К А         >         -ШКА,ЩОК    # дошка > дощок     (Р.)
# сестра - в /о


# м'яка група в Називному відмінку однини з закінченням на -я
# множина
SFX b    я      ь     [^іеуиаон'ьлтдр]я          # Вася   Вась    (Р.)
# МР 2001.09.02 родовий відмінок множини на -ря
SFX b    я      0     [^ео]ря          # буря   бур     (Р.)
# +++ ДК - зміни надані від vesna@ 11.06.02
SFX b    я      ь     еря              # вечеря  вечерь   (Р.)
SFX b    оря    ір    оря              # зоря  зір    (Р.)
# --- ДК - зміни надані від vesna@
#
# МР богиня кухня бойня вишня; 2001.09.02 -ЬНЯ,ЕНЬ
SFX b    я      ь     [іеиаоюуїає]ня            # богиня  богинь        (Р.)
SFX b    ня     онь   [кх]ня           # кухня  кухонь          (Р.)
SFX b    йня    єнь   йня              # бойня  боєнь           (Р.)
SFX b    ьня    ень   ьня              # вітальня  віталень     (Р.)
SFX b    ня     ень   [^іеиаоюуїяєнкхйь]ня        # вишня  вишень         (Р.)
# МР 2001.08.26 -лля -ття -дця  2001.09.02 -[вмб]ля 2001.09.14 -стя
# МР 2001.09.16 [^С] [С] -сля  (тесля - тесль) ?
SFX b    ля     ель   [^лоеуаієюяїиск]ля          # будівля будівель      (Р.)
SFX b    я      ь     [лоеуаієюяїиск]ля           # Валя  Валь    (Р.)
SFX b    я      ей    адя              # попадя  попадей     (Р.)
SFX b    я      ів    [^да]дя          # дядя  дядів     (Р.)
SFX b    я      ь     [^тс]тя          # Катя  Кать    (Р.)
SFX b    ля     ей    лля              # рілля  рілей     (Р.)
#        Т Л Я         >         -Я,ЕЙ       # рілля > рілей             (Р.)
SFX b    я      ів    уддя             # суддя  суддів     (Р.)
SFX b    дя     ей    аддя             # бадця  бадей     (Р.)
SFX b    тя     ей    ття              # стаття  статей     (Р.)
SFX b    я      ь     [^о]стя          # причастя  причасть    (Р.)
SFX b    я      ей    остя             # гостя  гостей     (Р.)
# МР                              Мар'я > Марей ?
SFX b    'я     ей    [^р]'я           # сім'я  сімей     (Р.)
```

Figure 12: Example of rules of morphological analysis for Ukrainian nouns

Let us explain the labeling for different groups of Ukrainian nouns.

- Group I is for nouns which are marked by a flag *a b c d o*:

- o The first declension: feminine, masculine and neuter nouns;
- o The second declension: masculine nouns ending in *-ар, -ир* are stressed (mixed group in *-ар, -ир*);
- o The third declension: masculine nouns with alternation *-і –о*;
- o Numerals in *-ять, -сят, -сто*.
- Group II is for nouns that are marked by a flag *e f g h*:
  - o Nouns of the second declension of the masculine gender with a zero ending;
  - o Nouns of the second declension of the male gender ending in *-о*.
- Group III is for nouns that are marked by a flag *i j k*:
  - o Nouns of the third declension without alternation;
  - o Nouns of the second declension of the neutral gender ending in *-о -а –я*;
  - o Nouns of the second declension with the consonant not ending in *-і* (Locative case).
- Group IV for nouns that are marked by a flag *l m n*:
  - o Nouns of the third declension with alternation;
  - o Nouns of the fourth declension of the neutral gender ending in *-а -я*.
- Group V for nouns which are marked by a flag *p*:
  - o Patronymics of the masculine (ч.) singular (о.) and plural (м.);
  - o Patronymics of the feminine (ж.) singular (о.).

We will describe each marked group of a set of rules in more detail with the indication of their total number. More than 1 200 rules for processing suffixes and endings are used for morphological analysis of Ukrainian nouns taking into account the alternation of letters.

- SFX *a* Y 235 rules # Singular:
  - o The first declension is feminine, masculine and neuter nouns.
  - o The second declension: masculine nouns ending in *-ар*, *-ир* are stressed (mixed group in *-ар*, *-ир*).
  - o The second declension: masculine nouns with alternation *-і -о*.
  - o Numerals in *-ять, -сят, -сто*.
- SFX *b* Y 365 rules # Plural
  - o The first declension is feminine, masculine and neuter nouns.
  - o The second declension: masculine nouns ending in *-ар*, *-ир* are stressed (mixed group in *-ар*, *-ир*).
  - o The second declension: masculine nouns with alternation *-і -о*.
  - o Nouns ending is in *-и* in the plural form.
- SFX *c* Y 53 rules:
  - o Nouns is the second declension, which in the genitive singular have the ending *-а*.
  - o In the genitive case, the singular ending *-а* have masculine nouns:
    - ▪ Names of persons and beings: *entrant* (*абітурієнт – абітурієнта*), *horse* (*кінь – коня*), *mosquito* (*комар – комара*), *Dmitry* (*Дмитро – Дмитра*);
    - ▪ Countable nouns: *notebook* (*зошит – зошита*), *knife* (*ніж – ножа*), *pencil* (*олівець – олівця*);
    - ▪ Cities: *Uzhhorod* (*Ужгород – Ужгорода*), *Ternopil* (*Тернопіль – Тернополя*);
    - ▪ Rivers (with a stressed ending): *Dnipro* (*Дніпро – Дніпра*), *Donets* (*Донець – Дінця*);
    - ▪ Names of length, area, weight, volume, time intervals: *meter* (*метр – метра*), *gram* (*грам – грама*), *week* (*тиждень – тижня*), but *year* (*рік – року*), *age* (*вік – віку*);
    - ▪ Terms: *atom* (*атом – атома*), *square* (*квадрат – квадрата*), *case* (*відмінок – відмінка*);

- Names of buildings and their parts: greenhouse (*парник – парника*), corridor (*коридор – коридора*), garage (*гараж – гаража*).
- SFX *o* Y 52 rules # Plural:
  - The first declension: nouns of feminine, masculine, and neuter gender with alternation in *o/i* and the appearance of *o* (*e*) in the genitive case plural;
  - The second declension is nouns of the neutral gender in *-o* with alternation in *o/i* in the genitive case plural.
- SFX *d* Y 40 rules:
  - Exclamatory case;
  - First conjugation (for endings [ая]);
  - Second conjugation is for endings [rngdblvk] with alternating *o/i* and dropping *e/o*.
- SFX *e* Y 19 # Singular:
  - Hard group of nouns ending in *-o*;
  - Hard group of nouns without an ending;
  - Hard group of nouns ending in hushing consonants;
  - The mixed group of nouns ending in quelling consonants;
  - Soft group of nouns ending in *-ŭ -iŭ*;
  - A quiet group of nouns ending in *–ь*;
- SFX *f* Y 24 rules # Plural and Singular (in gr. *e*):
  - Nouns of the second declension of masculine gender without an ending, or ending in *-o*;
  - Nouns ending in *-ок* which drop *-о* and change into *-а*.
- SFX *g* Y 3:
  - The genitive case is the second declension ending in *-а*.
- SFX *h* Y 4:
  - Second conjugation (required for endings of consonants other than *ЙЖЧШЩ*);
  - Nouns of the second masculine declension without an end.
- SFX *i* Y 47 rules # Singular:
  - Nouns of the third feminine declension without an ending;
  - Nouns of the third declension without alternation;
  - Nouns of the second declension of the neutral gender ending in *-o -a –I*;
  - Nouns of the second declension with the consonant not ending *-i* in the Locative case.
- SFX *j* Y 65 rules # Plural:
  - Nouns in the plural form * m, * e;
  - Nouns of the third declension, feminine gender, without an ending;
  - Nouns of the second declension of the neutral gender ending in *-o -a –I*;
  - Nouns ending in *-[iï]сть* change into *–a*;
  - Nouns of the third declension without alternation;
  - Nouns of the second declension with a consonant not ending in *-i* in the Locative case.
- SFX *k* Y 8:
  - Exclamations;
  - Nouns of the third feminine declension without an ending;
  - Singular feminine nouns modified out of an adjective.
- SFX *l* Y 39 rules # Singular:
  - Nouns of the third declension with alternation;
  - Nouns of the fourth declension of the neutral gender ending in *-а/-я*;

        o   Nouns of the second masculine declension in *-о*[дв]*ець* with a loss of *-e* and alternation of *o-i*.
- SFX *m* Y 66 rules # Plural:
  - o   Nouns of the third declension with alternation;
  - o   Nouns is the fourth declension of the middle gender ending in *–а/-я*.
  - o   Nouns are the second masculine declension in *-о*[дв]*ець* with a loss of *-e* and alternation of *o-i*.
- SFX *n* Y 9:
  - o   Alternation of *-i* into *–e*;
  - o   Alternation of *-i* into *–o*;
  - o   Ending in hushing consonants except for *–ь*;
  - o   Nouns of the third feminine declension without an ending;
  - o   Mixed group, second conjugation in *–яр*, and soft group in *-ар -ур*.
- SFX *q* Y 2:
  - o   Mixed group, second conjugation in *–яр*;
  - o   The soft group is in *-ар -ур* (stressed endings).
- SFX *p* Y 182:
  - o   Patronymics of the masculine (ч.) singular (о.) and plural (м.) form for male names;
  - o   Patronymics is the feminine (ж.) singular (о.) form.

It is rather complicated to generate terminal chains in English because the availability of articles and connecting noun groups with each other by appropriate preposition makes the tree longer and broader. The production of terminal chains in the Ukrainian language is complicated by case and gender differences of inflexions of the term used in context.

5. Conclusion

The mathematical method's application for analysing and synthesising texts in natural language dates back to the middle of the last century when scientists put considerable effort into developing mathematical algorithms and computer programs for processing natural language texts. The apparatus of generating grammars, proposed by N. Chomsky, models processes at the syntactic level of language – the selected structural elements of the sentence make it possible to describe syntactic constructions regardless of their content. The article shows the peculiarities of sentence synthesis of different languages applying the principles of generating grammar. The influence of norms and rules of speech on the course of grammar construction is considered. The application of generating grammars has a wide range of possibilities in developing and designing automated systems for processing multilingual information, linguistic support of computer linguistic systems, etc. In natural languages, it is possible to describe context-dependent phenomena as context-independent ones regarding context-free grammars principles. Then the description becomes more complex because of new categories and rules. The article deals with the introduction of new restrictions on the classes of the mentioned above grammars. If the number of characters in the right part of the rules is not less than in the left one, it is received unabridged grammars. Then, with the replacement of only one character, context-dependent grammars are obtained. If there is only one character in the left part of the rule, context-free grammars are accepted. No further natural restrictions can be imposed on the left side of the rules.

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