

# Method of Automated Identification of Metaphoric Meaning in *Adjective + Noun* Word Combinations (Based on the Ukrainian Language)

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**Abstract.** This article describes the methods of automated identification of metaphoric combinations Adjective + Noun based on dictionary definition. The research is carried out on the Ukrainian language, CYM – 11/Dictionary of Modern Ukrainian-11 and Grac v.3 corpus that served as the source of research material. On the basis of dictionary entry of the polysemantic adjective definitions two sample word lists are created that correspond to its direct and figurative meanings. Besides that, the method involves the creation of stable metaphors database fixed by explanatory or phraseological dictionaries. To perform the analysis it is recommended to compile the word frequency list of the noun-component definitions, compared to the sample word list, where each coincidence is ascribed a corresponding index according to the previously defined “sample” relative frequency; the sum of coincidence values for each sample coincidences is calculated. The higher value indicates either direct or figurative meaning of the collocation. The algorithm has been verified on a certain type of metaphoric combinations, besides, the list of selected adjectives to be processed includes only those adjectives which figurative meanings are fixed by dictionaries. The algorithm generates some inaccurate results for a number of noun-components thematic groups which habitually depends on the exactness of definitions, in other words, its typical character for a certain thematic category. The method’s accuracy constitutes 90% when analysis is performed according to separate meanings of the noun-component, when the whole definition is analyzed the accuracy is about 80%.

**Keywords:** metaphor, automated identification of metaphor, machine readable dictionary, dictionary entry, dictionary definition, frequency

## 1 Introduction

Scholars suggest different ways of automatic or automated metaphor identification based on specific algorithms. There are a number of software capable of metaphors processing, such as: CorMet [1], MetaNet [2] repository; Amsterdam metaphoric corpus [3, 4], ATT-Meta project [5, 6] and corpus of verbs annotated according to source and target of metaphoric transference [7].

Dolan [8] formerly suggested the algorithm of metaphors extraction from a machine readable dictionary. Some researches are based on cognitive approach to metaphor, in particular, P. Koivisto-Alankoa and H. Tissari's research [9] involves the identification of components that constitute target domain of metaphorization, then the target domain concepts' environment is analyzed, as well as the projection of metaphorization is defined [9, p. 191–213]. This type of researches also includes approaches based on the mechanism of lexemes retrieval that relate to both source and target domains [10].

This segment of analysis employs corpus data, i.e. semantic annotation of corpora. This method involves semantic annotation in order to retrieve metaphors-candidates from the source domain; it is based on the following principle: the tagged words in the corpus are supposed to relate to the source domain of metaphors. The method stipulates the semantic annotation of the entire corpus on the basis of dictionary data [11]. In some researches metaphor analysis algorithm starts from the probing of a certain part of the large corpus manually, subsequently the defined connections of language metaphors are proved on a great amount of empiric data [12, p. 184; 13, p. 82-92]. The study of large corpora belongs to [14].

The retrieval of metaphors is performed on the principle of “metaphor markers” [15]. This procedure includes obligatory comparison of words tagged as belonging to the source domain with concordances for verification of results [11, p. 152]. Al-Saggaf, Mohammad Ali; Mohd Yasin, Mohamad Subakir; Ho-Abdullah, Imran suggest semasiological approach to the identification of conceptual metaphors in a certain discourse applying quantitative and qualitative analysis [16].

Some scholars identify metaphors applying statistic methods [7,17-19]. After the candidate-metaphors have been retrieved metaphorization is assessed by statistic methods and the achieved results are verified manually by corpus annotators [20]. Caruso advocates the method of metaphors identification which is grounded on collocations selection in monothematic texts [21]. The specificity of this approach lies in selective identification of metaphor relating to a certain target conceptual sphere [21, 22]. T. Shimizu, M. Shimokura, suggest comparative approach employed in “T-Scope version 2.0” software to retrieve collocations [23, p. 329-343]. The main notion of their approach is ‘Mental Distance’ analysis, elaborated by T. Shimizu [24, p.245-268]. The available in modern linguistics methods of comparative identification of metaphors are based on different languages [25, 26].

Consequently, the represented in modern linguistics algorithms of metaphors identification have a set of common features, i.e. they involve text corpora as research material (in some cases such corpora are semantically annotated with the aim to solve the problem of homonymy and polysemy), the theoretical foundations of analysis

include the cognitive theory of metaphor, both qualitative and quantitative methods of analysis are applied simultaneously; some researchers suggest that the analysis should start with “manual” annotation.

## 2 Identification of Adjective + Noun Model of Metaphor Based on Dictionary Definition

The hypothesis of our research consists in the following: the dictionary entry of an explanatory dictionary contains information applicable for metaphor-candidates identification. СУМ-11 (Modern Ukrainian) (because СУМ-20 is being still developed) [27,28] and Grac v.3. [29] corpus constitute the material of our research. The algorithm does not involve previous manual annotation. However the user may specify the results opting for additional parameters, which are to be described further.

We will exemplify the algorithm of adjective+noun collocations metaphorization analysis by collocations *golden + noun* (the effectiveness of the method has been proved on collocations including adjectives *бездонний* ‘unfathomable’, *білий* ‘white’, *блідий* ‘pale’, *безмірний* ‘enormous’, *брудний* ‘dirty’, *кривавий* ‘bloody’, *гострий* ‘sharp’, *солодкий* ‘sweet’, *солоний* ‘salty’, *срібний* ‘silver’). In Grac v.3. corpus the collocations including adjective *golden/золотий* have been extracted (the list includes samples of the first 50 collocations, sorted out according to  $MI.log\_f$  coefficient, calculated by the formula

$$MI.log\_f = MI-Score * \ln(AB+1) \quad (1)$$

in descending order of the coefficient [30]): монета, рибка, медаль, ворота, Орда/орда, ланцюжок, перстень, віквіко, нитка, літера, годинник, зуб, хрест, яблуко, ланцюг, сережка, горагоріти, осінь, корона, прикраса, волосся, обручка, середина, дукат, пісок, палата, клітка, чаша, оправа, зірка/зіркий, ключик, Рог/Ріг/ріг, Липа/липа, браслет, фонд, зірка, руно, проміння, стандарт, яйце, каблучка/каблучок, ріг, запас/запасти, грамота, окуляри/окуляр, дощ, гудзик, гомін, шолом, руна/руно, бані/баня, ключ, зерно, кучер, Ріг/ріг, доба, обруч, баня, медальйон. The notional words село, історія, життя, мова complete this list.

The dictionary entry has a fixed structure: formal features (numbers, italics, bold type) make it possible to retrieve necessary information for database (see СУМ, v. 3, p. 680). The first stage of hypothesis verification involves the development of two sample word lists. These lists are developed from two different parts of dictionary definitions – representing direct and figurative meanings. Sample lists are word frequency lists – with words-constituents of direct and figurative meanings descriptions, in our case the word *golden*; they are the components of collocations with *golden*, extracted from the dictionary entry; words from their definitions are also included to a corresponding list (*Білорусь, дитина, дійсність, зять, синочок, людина, пора, сон etc.*); extracted from the dictionary entry phraseological units, definitions of phraseological units and definitions of their components. In our case the word *golden* is a components of the following word combinations: *верби золоті ростуть; золоте весілля; золоте відношення; золотий вік; золота голова; золоті гори обіцяти;*

*золоте дно; золотий дощ; золотий запас; золота лихоманка; золотий мільярд; золота молодь; золоті руки; золота рука у кого; золоте руно; золота середина; золоте серце; золоте слово; золоті слова; золота сторінка; золотий фонд; золота фортуна.* Dictionary markers and functional words are excluded from the frequency lists, developing in this way the so called stop-list. The relative frequency of a certain word in each list is assessed, which virtually indicates the value of each word. Then we search the component in database, that includes a certified list of metaphoric expressions retrieved from explanatory dictionary (except explanatory dictionary, information extracted from phraseological dictionaries may serve as additional sources of data). In our case we can observe the coincidences from the database: *рибка, середина, фонд, руно, стандарт, запас, дощ, вік, голова, монета, осінь, etc.*

The second stage. Concerning their form the metaphoric combinations are identified based on written representation of their nominal component – capital letters as an indication of their metaphoric meaning (the formal parameters also encompass inverted comas and capitalization of the word *golden* (that does not follow a full stop)): *Золоті Ворота, Золота Луна, Золотий Потік, Золотий Гомін, золота Прага, золота Білорусь, Золота Бутса, Золотий Гусь, “Золоте теля”, etc.* It is worth mentioning that Turney et al. [18] suggested the rule of identification of metaphors created according to the model adjective+noun that consists in rate of noun abstractness in the phrase. Similar rule can be applicable for our research: when the noun is marked “abstract” in the dictionary this collocation has the status of metaphoric expression.

The third stage. We look for the definition of the component which constitutes the collocation with *golden*. We develop the word frequency list for the component definition. This list is compared with the sample one, ascribing a certain index to each coincidence according to the previously defined “sample” relative frequency. We find the sum of coincidence values in each sample lists. The higher value will indicate either direct or figurative meaning of the collocation.

In some cases we can observe the absence of coincidence with the sample lists (word frequency list of the definitions of the word *diadema/ діадема: верховний, визначати, відкритий, вінець, дорогоцінний 2, жрець, жіночий, зразок, корона, невеликий, пов'язка, прикраса, самоцвіт, сан, урядовець*). For example, *золота діадема: Він уже вкотре передумував над застереженням Кукудзі й не міг позбавити себе єдиного бажання - ще раз подивитися на таємничі вогні, що здаються золотою діадемою на чолі гладесенької хвилі непокороної води/He again contemplated over Kukudza's warnings, however could not stand the temptation to look once more at the mysterious lights which resembled a golden diadema on the forehead of smooth wave of unsubdued water (literal translation) (Олександр Зима, День на роздуми, 1987. – All examples of contextual usage are selected from Grac v.3. corpus). The first notional word in the definitions of *diadem* is the word *crown/ вінець* (СУМ, vol. 2, 1971, p. 294). We develop the frequency list for the definitions of the word. The same procedure is applied to the collocation *золота бричка/ golden britzka (Тепер уже вірую, що нянько відпустив мені вину . Із такою славою зустрів нас на кордоні! — й хоче сідати в золоту бричку/ Now I do**

believe that father had forgiven me. He met us with glory at the border! — and wanted to get into the golden britzka (literal translation)(Петро Лінтур, Зачаровані казкою: Українські народні казки Закарпаття, 1950-1969)). We develop the frequency list for the definitions of the word *cart*.

### 3 Results of the algorithm application

Particular examples of metaphor identification according to the suggested method are represented in the table 1.

**Table 1.** Results of metaphor identification analysis

Component/s of collocation	Figurative meaning (quantitative results)	Direct meaning (quantitative result)	Either direct or figurative (metaphoric - m, direct - d)	Evaluation of the results (true- t, false - f)
1	2	3	4	5
баня 1.1.	0,176	0,000	m	t
баня 1.2.	3,779	2,614	m	t
баня 1.3.	5,097	5,229	d	t
баня 2.1.	5,097	5,229	d	t
баня 2.2.	1,142	1,961	d	t
батон	0,351	1,307	d	t
браслет	0,088	0,871	d	f
брелок	3,603	2,397	d	f
бризка	1,845	1,525	m	t
бриль	0,351	0,000	m	t
бричка	1,054	11,983	d	t
брошка	0,000	0,218	d	t
буква	0,527	0,871	d	t
булава	2,109	2,614	d	t
вакації	5,185	3,050	m	t

However, some commentaries are necessary. The results can be considered false in case when hypothetically an item can be golden, i.e. made of gold: браслет ‘bracelet, trinket’ (Вона наділа простий золотий браслет, надто масивний і важкий для її тендітного зап'ястка / She put on a simple golden bracelet, too massive and heavy for her tender wrist (literal translation) (А. Ренд, Джерело, 2016, EN, Олена Замойська); А біля застіжки на ланцюжку — золотий брелок у вигляді слова англійською / And near the buckle here is a trinket in the form of an English word (literal translation) (Люко Дашвар, Мати все, 2010, UA). Notably, that following the definition СУМ-20 provides correct result, for example, of the collocation golden bracelet (direct meaning - 0,654, figurative meaning - 0,264), although this result

cannot be considered significant, because the sample lists should be created according to СУМ-20.

#### 4 Results validity analysis

It has been analyzed 130 meanings of nouns-components of *golden + noun* combinations, “true” results occurred in 90% of cases, “false” – in 10% correspondingly. After the analysis of the entire definition results (an average exactness is 81,11%) and the analysis of separate meanings of a certain definition it becomes clear that the analysis according to the meanings provides for more exact results (the analysis according to the entire definition of the word *зребінчик* ‘comb’ gives false results: metaphoric meaning 4,130, direct – 1,961; analysis according to separate meanings gives more exact results: 1<sup>st</sup> meaning – metaphoric 0,439, direct 0,871, 2<sup>nd</sup> meaning – metaphoric 0,439, direct 0,871; 3<sup>rd</sup> meaning – metaphoric 0,439, direct 0; 4<sup>th</sup> meaning – metaphoric 2,988, direct 1,307.

Unfortunately, the analysis according to the separate meanings of a word requires “human” intervention or semantic annotation of the corpus. However the analysis according to separate meanings fails to achieve 100% results exactness, thus it is required to apply additional parameters, in particular, eventually, it could be effective to compare contexts – so called sample and analyzed ones.

The example *золотий дзвін* ‘golden bell’ is worth attention. In the corpus we come across 23 cases of the collocation *золотий дзвін* ‘golden bell’, among which there are 12 cases of figurative expressions (*...а голосок, який продзвенів серед зали, золотим дзвоном озвався/ ... and a little voice that tinkled in a hall resounded of golden tolling (literal translation)* (В. Шевчук, *Дім на горі, 1967-1980*); *...з квилінням чайки біля степового озера і золотим дзвоном пшеничної ниви за селом, із звуками рідної мови... / ... with a mewling of a gull near the lake in the stepp and with the golden tinkling of the field, with the sounds of mother tongue (literal translation)* (В. Малик, *Фірман султана, 1969*); *...в балачці, в стукоті гранчака об графин чувся золотий дзвін прощального листопаду.../ in a chatting, in the clank of a glass and a decanter there was heard a chime of parting November (literal translation)* (Є. Пашковський, *Вовча зоря, 1993*) і 11 – direct (*...захотілося мати на своєму судні золотий дзвін для постійної спокуси команди?/ ... we wanted to have on our ship a golden bell for a constant temptation of the crew (literal translation)* (М. Білкун, *Багато, багато, багато золота, 1975*), etc.). For example, the analysis of homonyms: **ДЗВІН 1** - metaphoric meaning 0,791, direct meaning 0,654 (false result); **ДЗВІН 2** – metaphoric meaning 1,054, direct meaning 0,654 (true result).

In spite of the fact that the definition of the first meaning of the word *дзвін* consists of 16 notional words, the achieved results are false. Instead of this the verification according to the first notional word of the definition gives true results (direct meaning - 0,87146, metaphoric meaning - 0,615114).

In case when the definition of the word contains (Каріна ж за зраду українського народу нагородили золотим годинником, напевно “трофейним”, знятим із руки

якоїсь жертви / Karin for the betrayal of Ukrainian people betrayal was rewarded with a golden watch, definitely a trophy one taken off a wrist of a victim (literal translation)(Р. Коваль, За волю і честь. Невигадані історії і вояцькі біографії, 2005)) only several words (for example: device that shows time) it is required to verify the meaning according to the first word of the definition, in the cited example, the word прилад ‘device’. When the definition of the word годинник ‘watch’ is used the results are false: direct meaning – 0,436, figurative meaning – 0,879. According to the definition of the word прилад ‘device’. the achieved results are correct: direct meaning – 5,229, figurative meaning – 5,097). The same is true for the combination золоті вакації ‘golden vacation’ (Наш герой попрощався зі своїм щирим приятелем, таки рішив пробитися крізь лінію на північному сході, щоб провести прекрасні дні золотих вакацій на березі рідної Тиси / Our hero bid farewell to his bosom friend and decided to break through a line on the North-East and spend his golden vacations on the banks of his beloved Tysa (literal translation)(В. Гренджа-Донський, Покрив туман співучі ріки...,1922-1934). The definition of the word vacation/ вакації contains only 6 notional words (заклад, канікули, навчальний, перерва, робота, установа). We can observe only one coincidence, that prognosticates the figurative meaning – 0,194363, direct meaning – 0. The first word in the definition of the word vacation is the word перерва ‘break’. Applying the definition of the word перерва ‘break’ we achieve the correct results: direct meaning – 3,050, figurative meaning – 5,185.

The analysis of the thematic group “natural substances” produces incorrect results; *золота вода* ‘golden water’ (... *пиєниці стояли непробивні, як золота вода... / the wheat was thick like golden water ... (literal translation)* (П. Загребельний, Левине серце, 1976)); *золотий дим* ‘golden smoke’ (*Ібрагім і Гріті... добралися до майдану, на якому стояв золотий дим від потужних ударів сонця крізь скісні вікна у високих сіро-чорних склепіннях / Ibrahim and Gritty reached the square enshrouded in a golden smoke from a strong sun strokes through the wall windows under the grey and black vaults (literal translation)* (П. Загребельний, Роксолана, 1980). The analyzed group includes the component *нісок* ‘sand’: the 1<sup>st</sup> meaning – metaphoric meaning 0, direct – 2,397 (correct result); 2<sup>nd</sup> meaning – metaphoric meaning – 2,285, direct meaning – 5,447 (incorrect result). In the cited example the collocation *золотий нісок* ‘golden sand’ is used in direct meaning: *Золотошукачі досить легко проходили з крізь м'яку каолінову породу, в яку були вкраплені золотоносні породи. Саме з них потім вимивали золотий нісок / Gold diggers easily drew through the soft kaolin rock deseminated by golden layers. It was there where the golden sand was washed off* (Новини Берегівщини, Загублені скарби Ференца Ракоці II або яку таємницю бережуть печери Берегівщини?, 2018, UA); in figurative meaning: *М'які лінії гір, золотий нісок, синява моря, що зливалася з синявою неба, сподобалися Суроїжкіну / Syroyizhlin liked the soft lines of the mountains, golden sand, blue of the sea that fused with the blue of the sky (literal translation)* (Є. Велтістов, Ресці невольнимий друг, 1988, RU, М. Видиш). Concerning this collocation the method produces false results.

It is worth mentioning that the first meaning of the word *golden* in СУМ / Dictionary of modern Ukrainian is “related to the gold mining. Золоті копальні ‘gold mine’;

Золота промисловість ‘gold mining industry’”. This type of meaning is interpreted as a direct one, however in this case we can observe a typical metonymy: *золотий відділ* ‘golden department’ (...*заробітна плата робітника золотого відділу була вдвічі вищою, ніж срібного...* / ... *the salary in the golden department was twice higher than in the silver one (literal translation)*) (І. Скоморович, 2017)). The analysis results according to the presented methodology provide for a figurative meaning.

The same is true for the collocation *золоте джерело* ‘golden source’ (*Золоті джерела в горах висохли, те, що в них було, тепер лежить у банківських сейфах* / *The golden sources in the mountains dried out the substance they contained is now deposited in bank strongrooms (literal translation)*) (Б. Фелькнер, *Долина Гнівного потоку*, 1972, С. Попович)). The results of the specifications according to the meanings: the 1<sup>st</sup> meaning – metaphoric 0,879, direct 0,654: 2<sup>nd</sup> meaning – metaphoric 0,351, direct 0,218 (correct result).

Further specification of the results can be performed applying, except the word frequency list of the word *джерело* ‘source’, the word frequency list of the word *creativity/творчість* as the following example is a sustained metaphor: *І золоте джерело творчості, що так буяло завжди в нашій господі, може знову заб'є живим ключем* / *And the golden source of creativity that thrived in our home might burst in a new live spring (literal translation)*) (Л. Старицька-Черняхівська, *Спогади про М. В. Лисенка*, 1932). The analysis results provide for the figurative meaning of the collocation – 5,185, direct one – 4,36. The same is true for the collocation: *золоті весла* ‘golden oars’ (*Ось вони, золоті весла часу!?* / *Here they are the golden oars of time (literal translation)*) (С. Велтістов, *Золоті весла часу або Іди іди*, 1990, М. Видиш)).

The analysis results according to the definition of the word *весло* ‘oar’ indicate that the collocation was used in direct meaning (direct meaning – 0,871; figurative meaning – 0,439367). The analysis results according to the definition of the words *oar/весло* and *time/час* indicate that the collocation was used in figurative meaning (direct meaning – 14,763, direct meaning – 9,3682).

The thematic group “objects of natural origin (nonartifacts)” produces dubious results. The contextual analysis reveals the direct meaning. For example, the word *яйце* ‘egg’: *А качка кинула в море золоте яйце* / *The duck threw a golden egg into the sea (literal translation)*) (Казки народів СРСР, 1954); *Проте Жар-птиця встигає знести золоте яйце, з якого навесні знову народжується (воскресає) джерело світла й тепла* / *The Firebird could lay a new golden egg that gives birth to a new life in the spring (literal translation)*(Г. Лозко, *Українське язичництво*, 2009); *apple/яблуко: У розпал бучного бенкету Ерида прокралася на весілля і кинула серед гостей золоте яблуко, яке зірвала в саду Гесперид* / *At the middle of the banquet Erida entered unnoticeably to the wedding and threw amongst the guests a golden apple that she picked in the garden of Gesperid (literal translation)*) (Міфи Давньої Греції, 2009).

It is worth attention that in the corpus most often we come across the collocation *золота голова* ‘golden head’ used in metaphoric meaning (*Хоч і неписьменна, але з золотою головою* / *Although she was illiterate she had a golden head (literal translation)*) (Вл. Івченко, *Найкращий сищик імперії на службі приватного капіталу*,



2012)). However there are cases of direct meaning: ... я вчора вдень бачив золоту голову богині Артеміди в руках одного жебрака, який ішов і веселився, і спитав я його, де взяв, і сказав мені, що Теодор Стратилат її дав йому / I saw a golden head of Artemida goddess in the hands of a beggar who walked gaily, and I asked him where did he got it and he told me that Teodor Stratylat had given it to him (literal translation) (Д. Туптало, Життя Святих Четї Мінеї Том VI Лютий, 2007-2008, В. Шевчук). To identify these meanings the application of additional parameters is necessary.

## 5 Conclusions

Taking into consideration the fact that it has been impossible so far to apply the available in English WordNet instruments of noun's concreteness/abstractness identifications we suggest the method of automated metaphor identification based on the dictionary definitions. The presented algorithm of automated identification of metaphoric combinations created on the model adjective+noun are based on the available nowadays in the Ukrainian language resources (machine readable dictionaries – both explanatory and phraseological that can be used for development of database; text corpora (without semantic annotations, in particular Grac v.3. corpus which can be used, however, for collocations extraction).

In other words, the semantic annotation in the corpus would considerably increase the effectiveness of the methodology. The suggested method (in case of analysis according to the different meanings of polysemantic word or meanings of homonyms) involves the “human” participation at those stages of identification when the meanings of the noun-component are applied.

The algorithm has been verified on a certain type of metaphoric combinations, besides there have been verified only adjectives with figurative meanings fixed by the dictionaries. The algorithm produces some inaccurate results for a number of thematic groups of nouns-components which usually depends on the exactness of the definition, i.e. its typicalness for a certain category. The exactness of the algorithm constitutes 80-90% depending on the character of applied procedures.

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