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# СЎЗ САНЪАТИ ХАЛҚАРО ЖУРНАЛИ

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**ONTOLOGICAL MODELING INFORMATION TECHNOLOGY TERMS IN UZBEK** <https://doi.org/10.5281/zenodo.20814841>**ABSTRACT**

This article provides a comprehensive analysis of ontological modeling information technology (IT) terms in the Uzbek language. The study aims to evaluate the formation of IT terminology in Uzbek based on lexicographic principles and to determine its position within a conceptual system through an ontological approach. In order to achieve this objective, the research identifies the mechanisms of term assimilation, examines their representation in lexicographic sources, evaluates semantic and structural adaptation, and analyzes ontological relations like hyponymy and meronymy. The methodology combines lexico-semantic analysis, comparative analysis, conceptual analysis, and ontological modeling. The corpus includes selected IT terms (e.g., *server, database, interface, protocol, firewall, cloud computing*) from software, networking, and data management domains. The findings indicate that borrowing is primarily realized through transliteration and partial calquing; however, consistency and standardization remain insufficient. Lexical definitions often fail to capture conceptual depth, leading to variability and ambiguity within the terminological system. Ontological analysis demonstrates that hierarchical and partitive relations enable the integration of terms into a structured knowledge system. The study concludes that effective adaptation requires the integration of lexicographic and ontological approaches. This contributes to terminology standardization, improved scientific communication, and the development of structured terminological resources.

**Key words:** information technology terminology, foreign terms, lexicographic adaptation, terminological systematization, ontological modeling, hyponymic relations, meronymic relations, semantic features of terms, structural features of terms, transliteration, loan translation (calquing), term variability, conceptual system, ontological dictionary.

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**AXBOROT TEXNOLOGIYALARI TERMINLARINI O'ZBEK TILIDA  
ONTOLOGIK MODELLASHTIRISH****ANNOTATSIYA**

Mazkur maqolada axborot texnologiyalari (AT) terminlarini o'zbek tilida ontologik modellashtirish masalasi har tomonlama tahlil qilinadi. Tadqiqotning asosiy maqsadi o'zbek tilidagi AT terminologiyasining shakllanishini leksikografik tamoyillar asosida baholash hamda ularning konseptual tizimdagi o'rnini ontologik yondashuv orqali aniqlashdan iborat. Ushbu maqsadga erishish uchun tadqiqotda terminlarning o'zlashtirilish mexanizmlari aniqlanadi, ularning leksikografik manbalarda ifodalanishi o'rganiladi, semantik va strukturaviy moslashuvi baholanadi hamda giponimiya va meronimiya kabi ontologik munosabatlar tahlil qilinadi.

Metodologiya leksik-semantik tahlil, qiyosiy tahlil, konseptual tahlil va ontologik modellashtirish usullarini o'z ichiga oladi. Tadqiqot materiali sifatida dasturiy ta'minot, tarmoqlar va ma'lumotlarni boshqarish sohalariga oid tanlangan AT terminlari (masalan, *server*, *ma'lumotlar bazasi*, *interfeys*, *protokol*, *fayrvol*, *bulutli hisoblash*)dan foydalanildi.

Natijalar shuni ko'rsatadiki, terminlarning o'zlashtirilishi asosan transliteratsiya va qisman kalkalash orqali amalga oshiriladi, biroq izchillik va standartlashuv darajasi yetarli emas. Leksik ta'riflar ko'pincha tushunchaning konseptual chuqurligini to'liq aks ettirmaydi, bu esa terminologik tizimda variantlilik va noaniqlikka olib keladi.

Ontologik tahlil esa ierarxik va qism-butun munosabatlari terminlarni yaxlit bilim tizimiga integratsiya qilish imkonini berishini ko'rsatadi. Tadqiqot xulosasiga ko'ra, samarali moslashuv leksikografik va ontologik yondashuvlarning integratsiyasini talab qiladi. Bu esa terminologiyani standartlashtirishga, ilmiy muloqotni yaxshilashga hamda strukturaviy terminologik resurslarni rivojlantirishga xizmat qiladi.

**Kalit so'zlar:** axborot texnologiyalari terminologiyasi; xorijiy terminlar; leksikografik moslashuv; terminologik tizimlashtirish; ontologik modellashtirish; giponimik munosabatlar; meronimik munosabatlar; terminlarning semantik xususiyatlari; terminlarning strukturaviy xususiyatlari; transliteratsiya; kalkalash; termin variantlilik; konseptual tizim; ontologik lug'at

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## ОНТОЛОГИЧЕСКОЕ МОДЕЛИРОВАНИЕ ТЕРМИНОВ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ В УЗБЕКСКОМ ЯЗЫКЕ

### АННОТАЦИЯ

В данной статье представлен комплексный анализ онтологического моделирования терминов информационных технологий (ИТ) в узбекском языке. Цель исследования заключается в оценке формирования ИТ-терминологии в узбекском языке на основе лексикографических принципов, а также в определении её места в концептуальной системе с использованием онтологического подхода.

Для достижения поставленной цели в работе выявляются механизмы заимствования терминов, исследуется их отражение в лексикографических источниках, оценивается их семантическая и структурная адаптация, а также анализируются онтологические отношения, такие как гипонимия и меронимия.

Методология исследования включает лексико-семантический анализ, сравнительный анализ, концептуальный анализ и онтологическое моделирование. В качестве материала исследования использованы отобранные ИТ-термины (например, *server*, *database*, *interface*, *protocol*, *firewall*, *cloud computing*) из областей программного обеспечения, сетевых технологий и управления данными.

Результаты исследования показывают, что заимствование терминов в основном осуществляется посредством транслитерации и частичного калькирования, однако уровень их согласованности и стандартизации остаётся недостаточным. Лексические определения зачастую не отражают концептуальную глубину понятий, что приводит к вариативности и неоднозначности в терминологической системе.

Онтологический анализ демонстрирует, что иерархические и партитивные (часть–целое) отношения способствуют интеграции терминов в структурированную систему знаний. В заключение отмечается, что эффективная адаптация требует интеграции лексикографического и онтологического подходов. Это способствует стандартизации терминологии, улучшению научной коммуникации и развитию структурированных терминологических ресурсов.

**Ключевые слова:** терминология информационных технологий; заимствованные термины; лексикографическая адаптация; систематизация терминологии; онтологическое моделирование; гипонимические отношения; меронимические отношения; семантические характеристики терминов; структурные характеристики терминов; транслитерация; калькирование; вариативность терминов; концептуальная система; онтологический словарь

### INTRODUCTION

In recent years, as a result of the rapid development of information and communication technologies, the terminology of this field has expanded dramatically, becoming a complex and multi-layered system. New concepts arising in the process of global scientific and technological progress are named mainly through the English language and are actively entering various national languages, including Uzbek. As a result, the widespread use of foreign information technology terms in the Uzbek language is observed. However, since this process often occurs chaotically and outside of normative criteria, problems such as formal and semantic incompatibility of terms, variability, and explanatory uncertainty arise [L'Homme, 2020; 45-52].

In modern terminology theory, terms are interpreted not only as nominative units, but also as elements of a conceptual system within a certain field of knowledge. From this point of view, the adaptation of foreign IT terms to the Uzbek language is not only a process of linguistic transformation, but also requires their correct placement in terms of content (semantic) and conceptual (ontological) aspects. Traditional lexicographical approaches are often limited to the interpretation of terms and cannot adequately reflect their interrelationships and place within the system. This creates difficulties in the process of systematizing scientific knowledge and standardizing terminology [Lyons, 1977; 112-118; Cruse, 2004; 136-140].

For example, the English term "cloud computing" is often translated into Uzbek as "bulutli hisoblash" through loan translation (calque). However, the conceptual content of this term is not fully revealed only by linguistic translation, but also requires its functional place within the system and its connection with other terms. Similarly, the term "database" is translated as "ma'lumotlar bazasi," but in some cases, its abbreviated or incorrect variants are encountered, violating the terminological consistency. This situation shows that it is necessary not only to translate terms, but also to correctly place them in the conceptual system [Newmark, 1988; 98-105]. The ontological approach is of particular importance in solving this problem. Within ontology, terms are considered as a system of interconnected concepts, and hierarchical (hyponymic), structural (meronymic), and associative relations between them are defined. This approach allows not only to interpret terms, but also to structurally place them within a single system of knowledge. Especially in such a rapidly developing field as information technology, ontological models of terms are an important tool for regulating scientific knowledge and effectively organizing information [Guarino, 1998; 5-12; Cimiano, 2006; 23-30].

At the same time, the assimilation of foreign terms occurs through various linguistic mechanisms, including transliteration, transcription, and loan translation (calque). However, the absence of a single standard in these processes leads to variability and semantic uncertainty in the terminological system. Therefore, the systematic study of the adaptation of foreign IT terms in the Uzbek language, the determination of the harmony between their lexical expression and conceptual content is an urgent scientific task [Cabr , 1999; 87-94].

Ontological modeling is a scientific-methodological process aimed at formally and structurally expressing the system of concepts existing within a specific field of knowledge, their semantic properties, and their interrelationships. In this approach, concepts are interpreted not as separate lexical units, but as elements of a conceptual system, and the hyponymic (species-genus), meronymic (part-whole), as well as functional and associative relations between them are determined and modeled in the form of a hierarchical and networked structure. The primary objective of ontological modeling is to systematize knowledge, organize it based on logical consistency, and create a semantically refined knowledge base [Abduraxmonova, 2020]. In particular, the study of information terminology, the presentation of differences between this approach, their standardization, and ontological vocabulary. As a result, the system manifests itself not as a fragment, but as a complex of elements.

Ontological modeling is a complex scientific process with the identification, organization, and systematization of knowledge expressed through linguistic language. In this approach, it is considered as a unit, but also as a semantic unit expressing  $\infty$ . Linguistic ontological modeling requires the first definition of lexico-semantic polysemy, synonymy, antonymy, hyponymy, and meronymy. In particular, hyponymic (genus) and meron(whole) serve as the main means of ontological hierarchy.

As a result, ontological modeling is closely related to linguistics, which allows us to consider systems as a formal model, but also as a complex relationship between language and thought.

The purpose of this research is to determine the features of lexicographic adaptation of foreign information technology terms that have entered the Uzbek language and to analyze their place in the ontological system on a scientific basis.

To achieve this goal, the following tasks were defined: to determine the mechanisms of assimilation of foreign IT terms; to analyze the features of their presentation in dictionaries; to evaluate the semantic and structural features of terms; to determine the ontological relationships between terms and to substantiate the interrelationship of lexicographic and ontological approaches.

The object of the research is a set of foreign terms related to the field of information technology. The subject of the research is the lexicographical adaptation and ontological placement of these terms in the Uzbek language.

The research methodology is based on the methods of lexico-semantic analysis, comparative analysis, conceptual analysis, and ontological modeling. The research material served as a corpus of selected terms related to the fields of software, computer networks, and databases.

The scientific novelty of this research is that the adaptation of foreign information technology terms in the Uzbek language is comprehensively analyzed in the combination of lexicographic and ontological approaches, and the place of terms in the conceptual system is clarified. The research results have important theoretical and practical significance in the standardization of information technology terminology, the creation of ontological dictionaries, and the improvement of scientific communication.

### **METHODOLOGY**

In this research, the issues of lexicographic adaptation and ontological placement of foreign information technology terms that have entered the Uzbek language were studied on the basis of a comprehensive approach. In the research process, the linguistic form, semantic content, and place of terms in the conceptual system were consistently analyzed, and a number of scientific methods were used. In particular, lexico-semantic, comparative-typological, conceptual, and ontological modeling methods formed the main methodological basis.

1. Lexical-semantic analysis is a method that serves to determine the semantic structure of terms, semantic components, and the dynamics of their change. With the help of this method, the cases of semantic expansion, narrowing, or metaphorical migration arising in the process of borrowing foreign IT terms into the Uzbek language were analyzed. The discrepancies between the lexical definition of terms and their conceptual content were identified, and the level of explanatory accuracy was assessed [L'Homme, 2020; 67-74].
2. Comparative-typological analysis was carried out by comparing original terms in English and their equivalents in Uzbek. This method played an important role in determining the mechanisms of borrowing foreign terms, including the processes of transliteration, transcription, and loan translation (*calque*). For example, a comparative analysis of the variants of the use of terms such as *server*, *interface*, *protocol* in the Uzbek language was carried out, and their level of standardization was assessed [Newmark, 1988; 102-110].
3. Conceptual analysis is a method aimed at determining the place of the concepts expressed by terms in the system of knowledge, in which terms are considered not as a separate unit, but as an element of a system of interconnected concepts. Based on this method, the semantic connections of terms within the framework of such basic concepts as "kompyuter tizimi," "tarmoq," "ma'lumotlar bazasi" were determined, and their conceptual hierarchy was revealed [Lyons, 1977; 245-252].
4. Ontological modeling is one of the central research methods, which involves identifying hierarchical (hyponymy), structural (meronymy), and functional relations between terms and placing them in a single system. With the help of this approach, terms were structurally modeled based on the relations "is-a" and "part-of." As a result, not only lexical, but also conceptual connections of terms were clarified [Guarino, 1998; 8-15; Cimiano, 2006; 41-49].
5. Structural analysis - aimed at studying the morphological and syntactic structure of terms. With the help of this method, the features of the formation of simple, derived, compound, and multi-component terms were analyzed, and the degree of their structural adaptation in the Uzbek language was assessed. In particular, the cases of structural simplification or complication of multi-component terms arising in the translation process were considered separately [Cabr , 1999; 120-128].
6. Based on the corpus, a set of selected terms (*server*, *database*, *interface*, *protocol*, *firewall*, *cloud computing*, etc.) related to the fields of software, computer networks, and databases was formed as analysis - research material. These terms were collected based on scientific sources, explanatory dictionaries, and practical IT texts, and their frequency of use and variants were analyzed.

The implementation of these methods ensured the reliability and scientific validity of the research results. In particular, the integration of lexicographic and ontological approaches made it possible to interpret terms not only as linguistic units, but also as an important element of the system

of knowledge. At the same time, the methods used in the study served to systematically reveal the process of adaptation of foreign IT terms in the Uzbek language.

**RESULTS AND DISCUSSION**

The results of this study showed that there are a number of important regularities and problems in the process of adapting foreign information technology terms to the Uzbek language and their placement in the ontological system. In the process of analysis, lexicographic and ontological approaches were used in harmony based on the selected corpus of terms, and the formal, semantic, and conceptual features of terms were deeply studied.

1. Results of lexicographic representation of foreign IT terms

According to the results of the analysis, it was found that the borrowing of foreign IT terms in the Uzbek language is mainly carried out through three main mechanisms:

transliteration (server, router, browser)

loan translation (calque) (cloud computing → bulutli hisoblash, machine translation → mashina tarjiması)

mixed model (database → ma'lumotlar bazasi)

The following table shows the adaptation characteristics of some terms:

**Table 1. Lexicographic representation of IT terms**

Term	Original meaning	Uzbek form	Ways of translation
Server	Service system	Server	Transliteration
Database	Structured data storage	Ma'lumotlar bazasi	Calque
Interface	Interaction boundary interface	Interfeys/interface	Variability
Protocol	Communication rules	Protokol	Transliteration
Cloud computing	Remote computing model	Bulutli hisoblash	Calque

The analysis shows that terms entered through transliteration quickly adapt formally, but their semantic content is often not sufficiently revealed. On the contrary, although terms translated by calquing are more understandable, their conceptual accuracy is not always ensured [Newmark, 1988; 103-110].

In addition, it was observed that the problem of variability in terms is widespread. For example, the term interface appears in Uzbek texts in the forms “interface”, “interfeys,” and sometimes “aloqa oynasi”. This indicates a lack of consistency in the terminological system.

**Semantic and structural features of terms**

The results of the analysis showed that the adaptation of foreign IT terms that have entered the Uzbek language is not limited to phonetic or graphic assimilation; this process is accompanied by semantic reinterpretation of terms, structural reorganization, and integration into the system of industry knowledge. In modern terminological research, the term is interpreted not as a simple nominative unit, but as a unit carrying special knowledge, mediating between the text and the conceptual system. Therefore, the adoption of a term in the Uzbek language is determined not by its form, but by the meaning and within which system it is used.

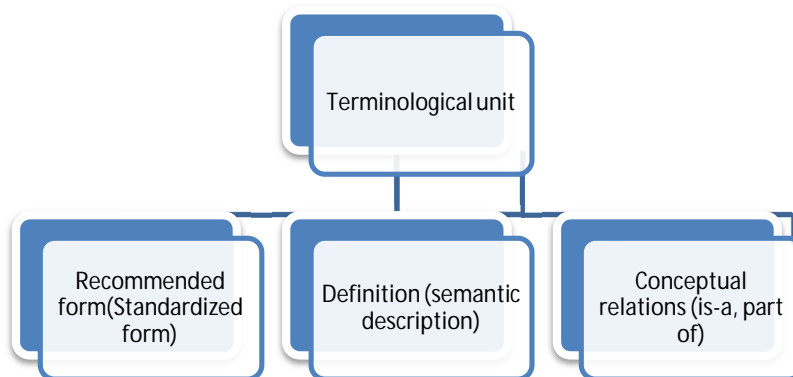
In this study, it was established that the semantic transformation of foreign IT terms is mainly manifested in three directions: *semantic expansion*, *semantic narrowing*, and *metaphorical terminologization*. In semantic expansion, the unit initially denoted a specific object or process, and in IT discourse, an abstract, systemic, or service-related concept is formed from it. For example, the lexeme cloud transitions from the natural language meaning "cloud" to the "model of remote computing and network resource provision" in IT. “Bulutli texnologiyalar” and “bulutli hisoblash” units in the Uzbek language partially reflect this semantic expansion, but in some texts the “bulut” component is perceived figuratively, and its technical and infrastructural content is not sufficiently revealed. Therefore, although the calque form is understandable, it does not always guarantee conceptual completeness. Semantic narrowing, on the contrary, was observed when a unit in the

general language or broader scientific circulation was attached to a specific functional content in a specific field. For example, a protocol in a general sense can mean a procedure or a formal transaction regulation, but in IT, it mainly refers to a set of rules for data transmission during the communication process. In the Uzbek language, the protocol(protokol) form is actively used, but in many cases, it differs only in context, since it is formally the same as an administrative-legal or diplomatic "protocol." This situation indicates that the formal stability of the term has been preserved, but the semantic sphere is confined to a narrow spherical function. The third important direction is metaphorical terminologization. In terminological research of recent years, it has been repeatedly emphasized that metaphor is not a peripheral phenomenon of the formation of scientific and technical terms, but an active cognitive mechanism. In IT terms, units such as *firewall*, *cloud*, *virus*, *cookie*, *tunnel*, *tree*, *architecture* are formed directly on a metaphorical basis. For example, the term firewall is often transliterated in Uzbek practical texts, sometimes interpreted as a “xavfsizlik devori”. An important aspect here is that the metaphorical basis facilitates the user's initial understanding, but in scientific lexicography, such terms require not only relying on the image, but also clearly indicating their functional-semantic boundaries.

Semantic analysis also showed that the principle of one form-one concept has not yet been fully established in the terms of IT in the Uzbek language. Especially in cases where several Uzbek variants of the English term are used in parallel, the ambiguity of meaning increases. For example, for interface, there are options such as “interfeys”, “foydalanuvchi interfeysi”, and in some educational texts, there are options such as “aloqa muhiti” or “muloqot oynasi”. In modern works on the creation of terminological resources in the digital environment, the control of such variability, the separation of the main form of the term, its synonymous form, prohibited or unrecommended forms is indicated as an important requirement of terminography[Faber, 2022].

Structurally, the research results showed that the share of multi-component nominations in IT terminology is increasing compared to simple units. This situation is not unique to the English language; Terminological observations in 2024 also noted an increase in complex terms and abbreviations in the new special lexicon. Although simple or single-component borrowings such as server, router, browser are actively used in the Uzbek language, as the field deepens, multi-component units such as data center, operating system, machine learning model, distributed database management system increase. Such units give three results in translation and adaptation: complete calque, partial calque+assimilation, or structural simplification.

Based on the conducted analysis, it can be argued that the structural adaptation of IT terms in the Uzbek language is largely governed by the principle of linguistic economy and ease of use (cognitive/functional usability). However, for scientific terminology, brevity alone is not sufficient; even if a term is structurally concise, it must not compromise conceptual precision. Therefore, in terminographic resources, it is essential to represent at least three layers for each term: (1) the recommended standard form, (2) its definition, and (3) its conceptual relations [Faber, 2022]. Without this triadic structure, modern terminological databases or ontological dictionaries cannot function effectively. The following diagram shows three important aspects of a terminological unit:

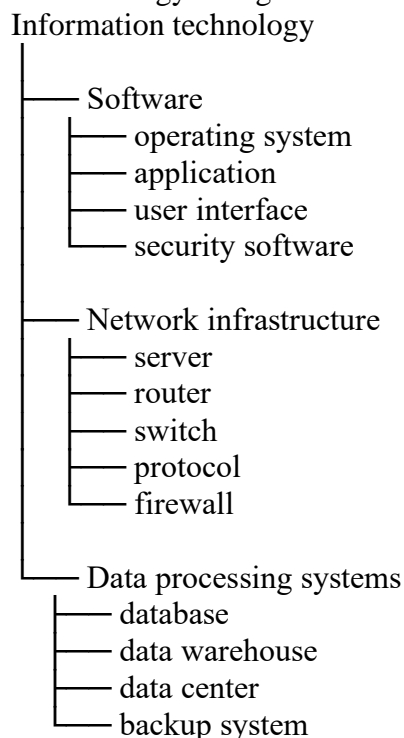


**Ontological Modeling Results**

One of the most significant findings of this study is that organizing or interpreting foreign IT terms solely in alphabetical order does not adequately reflect their scientific nature. In actual usage,

terms do not function as isolated units; rather, they exist within a structured conceptual network. Recent research at the intersection of terminology and ontology demonstrates that the ontological component plays a crucial role in integrating specialized vocabulary into digital and terminographic resources. Ontology provides answers to fundamental questions such as: *which unit belongs to which class?*, *which unit constitutes part of a larger system?*, and *which unit is associated with which process?*

In the analysis of this article, IT terms are grouped around three major nodes: software, network infrastructure, and data processing systems. Such a classification made it possible to see terms not as an abstract list, but as a subject-industry model. As a result, it became clearer which level a term belongs to, which term has a gender-type (hypernym-hyponym) relationship, and which term has a whole-part (whole-part) relationship. This approach corresponds to frame-based terminology and the methodology of digital terminological resources.



In this model, the server is located as a node belonging to the "network infrastructure" class. However, there is a subtle point here: it is not always enough to define a server only as a "device," since in modern IT discourse it is also used as a physical device, a virtual service environment, or a service logical node. Consequently, in ontological placement, it is necessary to take into account not only the lexical meaning of the term, but also its functional range in use [Kockaert & Steurs, 2021]. This is one of the main points that distinguishes the terminological description from the ontological description.

During the analysis, hyponymic and meronymic relations were examined in detail. In hyponymic relations, a term is subordinated to a higher-level generic concept; for example, *router*, *switch*, and *server* belong to the class of network devices or network nodes. In meronymic relations, a unit is described as a component of a larger system; for instance, the *user interface* is a part of an application, while a *schema* constitutes a structural component of a database. Recent studies in ontology emphasize that the formal representation of such relations is a necessary condition for transforming terminological resources into machine-readable formats. Another important finding is that many terminographic descriptions in Uzbek include the textual form of a term but lack its conceptual positioning. In other words, while a definition is provided, its higher-level category, subordinate types, structural components, and functional relations are often not specified. As a result, users may partially understand the meaning of a term, yet fail to determine its place within the overall knowledge system. Contemporary research in ontological terminology is specifically aimed at addressing this gap.

## CONCLUSION

This study has demonstrated that the adaptation of borrowed IT terminology in Uzbek is a multidimensional process involving lexical, semantic, and conceptual transformations. The findings confirm that effective terminology development requires not only linguistic representation but also integration into a structured conceptual system. The analysis highlights persistent issues such as variation, lack of standardization, and insufficient conceptual representation in existing terminographic resources. These challenges limit the usability and coherence of the terminological system.

The study argues that an effective model of terminology must incorporate three essential components: a standardized form, a precise definition, and clearly defined conceptual relations. This triadic model ensures both linguistic clarity and conceptual integrity. Besides, the integration of lexicographic and ontological approaches is essential for developing modern terminological resources, including digital databases and ontological dictionaries. Future research should focus on the implementation of such models in computational and corpus-based environments.

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