



Kaunas University of Technology
Faculty of Social Sciences, Arts and Humanities

Variability of Artificial Intelligence Related Terms Used in Translation from English into Ukrainian

Master's Final Degree Project

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Translation and Localisation of Technical Texts (6211NX031)

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Summary

This research is aimed at analyzing the influence of context on terminological variations in translation examples from English into Ukrainian based on the main features of translation-oriented terminology work and artificial intelligence-related concept models. This goal is achieved by completing several tasks, such as: a literature analysis of translation-oriented terminology related publications for identifying the aspects of work with terminological units and their variations for translators; defining the motivations for terminological variation as well as the contextual features causing this process; analyzing the artificial intelligence-related concepts and relationships among them in the English and Ukrainian languages; explaining the relevance of using terminological variations from the field of artificial intelligence in a particular context on the example of translation from English into Ukrainian.

Based on the systematic review of translation-oriented terminology research, it is defined that the term formation directly depends on a configuration of available concepts in a certain language within the analyzed thematic field. It is revealed that terminology work for translation purposes requires seeing into the typology of terms in order to follow the commonly established practice of term usage according to the standards as well as considering possible definitions and the context in which the term can be used. The essence of terminological variation as a linguistic phenomenon and possible reasons for its emergence are described. Thereby, a flow of terminology work for translation purposes, and the impact of contextual features on the selection of terminological variants are outlined. In this regard, terminological variants in the newly established field of artificial intelligence appear either in both English and Ukrainian languages, or in one of those due to a specific understanding of objects and ideas in a particular language.

The main concepts in English and Ukrainian, which may include both terms and variants, in the field of artificial intelligence are identified. On the example of building a basic concept model with the respect to the core concept of artificial intelligence, the differences in understanding similar concepts in the English and Ukrainian languages are explained. Considering these differences, the contextually motivated ways of using the artificial intelligence-related terms or terminological variants in the examples of translation from English into Ukrainian are provided. The relevance of using these terminological units in particular examples is justified by the contextual features expressed in the analyzed translations.

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Santrauka

Šio tyrimo tikslas – išanalizuoti konteksto įtaką terminologinėms variacijoms vertimo iš anglų į ukrainiečių kalbą pavyzdžiuose, remiantis pagrindiniais į vertimą orientuoto terminologinio darbo ir su dirbtiniu intelektu susijusių sąvokų modelių bruožais. Šio tikslo siekiama atlikus keletą užduočių, tokių kaip: literatūros, susijusios su vertimu orientuota terminologija, analizė, reikalinga siekiant nustatyti vertėjų darbo su terminologiniais vienetais ir jų variacijomis aspektus; terminologinių variacijų motyvacijos ir šį procesą lemiančių konteksto ypatybių apibrėžimas; su dirbtiniu intelektu susijusių sąvokų ir jų tarpusavio ryšių anglų ir ukrainiečių kalbose analizė; dirbtinio intelekto srities terminų variantų vertimo iš anglų į ukrainiečių kalbą pavyzdžiuose tyrimas siekiant nustatyti jų vartojimo aktualumą konkrečiame kontekste.

Remiantis sisteminė į vertimą orientuotos terminologijos tyrimų apžvalga, apibrėžiama, kad terminų formavimas tiesiogiai priklauso nuo tam tikros kalbos turimų sąvokų konfigūracijos analizuojamoje teminėje srityje. Atskleidžiama, kad vertimo terminologijos darbui reikia įsigilinti į terminų tipologiją, kad būtų laikomasi visuotinai nusistovėjusios terminų vartojimo praktikos pagal standartus, taip pat atsižvelgti į galimus apibrėžimus ir kontekstą, kuriame terminas gali būti vartojamas. Aprašoma terminologinio varijavimo kaip lingvistinio reiškinių esmė ir galimos jo atsiradimo priežastys. Tuo būdu nusakoma terminologinio darbo vertimo tikslais eiga ir konteksto ypatybių įtaka terminologinių variantų atrankai. Atsižvelgiant į tai, terminų variantai naujai kuriamoje dirbtinio intelekto srityje atsiranda arba tiek anglų, tiek ukrainiečių kalbose, arba tik vienoje iš jų dėl specifinio objektų ir idėjų supratimo tam tikroje kalboje.

Išskiriamos pagrindinės dirbtinio intelekto srities sąvokos anglų ir ukrainiečių kalbomis, kurios gali apimti ir terminus, ir variantus. Remiantis pavyzdžiu, kai sudaromas pagrindinis sąvokų modelis, atsižvelgiant į pagrindinę dirbtinio intelekto sąvoką, paaiškinami panašių sąvokų supratimo skirtumai anglų ir ukrainiečių kalbose. Atsižvelgiant į šiuos skirtumus, pateikiami kontekstiškai motyvuoti su dirbtiniu intelektu susijusių terminų ar terminologinių variantų vartojimo būdai vertimo iš anglų į ukrainiečių kalbą pavyzdžiuose. Šių terminologijos vienetų vartojimo tikslingumas konkrečiuose pavyzdžiuose pagrindžiamas analizuojamuose vertimuose išreikštomis kontekstinėmis ypatybėmis.

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Introduction

This research is an attempt to analyze possible variability of terms in the field of artificial intelligence, the concepts related to these terms and possible contextual features motivating the emergence of such variability in the modern English and Ukrainian languages. New realia and concepts influencing the emergence of terms in both language systems can potentially be considered for translation of the mentioned thematic area and are going to be introduced. The main views on terminological variation proposed by Rogers (2004), Cabre (1999), Freixa & Fernandes-Silva (2009), Karremans (2010), Gambier (2010), Thelen (2013) and Faber (2019) in the context of translation have been outlined. However, much uncertainty exists about general applicability of one particular model to specific examples of terminology used in the domain of artificial intelligence. Also, translating texts in the thematic area of artificial intelligence causes a high level of confusion while picking up the relevant terms, since the field of science is relatively new, new concepts are not in time to receive their designations even in the English language, and the interdisciplinary interference creates multiple versions of one and the same concept.

Research results can be used in compiling terminology databases on the topic of IT industry and artificial intelligence, in translation practice to avoid ambiguity and confusion while dealing with the terms and their variations.

The overall **aim** of research is to analyze the influence of context on terminological variations in translation examples from English into Ukrainian based on the main features of translation-oriented terminology work and artificial intelligence-related concept models.

Objectives:

1. To do systematic literature analysis of translation-oriented terminology related publications for identifying the aspects of work with terminological units and their variations for translators.
2. To define the motivations for terminological variation as well as the contextual features causing this process;
3. To analyze the artificial intelligence-related concepts and relationships among them in the English and Ukrainian languages;
4. To explain the relevance of using terminological variations from the field of artificial intelligence in a particular context on the example of translation from English into Ukrainian.

Research question is whether the reasons for selecting the terminological variations in the field of artificial intelligence can be justified by particular contextual features and, if so, how to define those in the process of translation from English into Ukrainian.

Background

Talking about the work already done in this area, Microsoft Corporation provides the widest range of information services and linguistic support to the Translation Services, interpreters, external translators and other users by hosting the Language Portal ¹ with an opportunity to look up the terminology translations in different languages and by various product categories for dynamic translation and localization, and the Glossary², which can be downloaded for checking the IT

¹ <https://www.microsoft.com/en-us/language>

² <https://www.microsoft.com/en-us/language/Terminology>

terminology of localized versions of Microsoft products in more than 100 languages. English Machine Learning Glossary including general terms and definitions is introduced by Google Corporation³. The Council of Europe has introduced its AI Portal⁴ containing news, articles (including academic), and a glossary, however, the work is still in progress and the resources represent superficial information. The publishing company “Springer” regularly contributes to publishing Artificial Intelligence Reviews, which are “state-of-the-art research reports and critical evaluations of applications, techniques, and algorithms in artificial intelligence, cognitive science, and related disciplines.” (<https://www.springer.com/journal/10462>). Ukrainian-language AI resources are mostly accumulated on the platform of Institute of Artificial Intelligence Problems under MES and NAS of Ukraine⁵, providing the publications, news, and description of the Institute’s own elaborations in the Ukrainian language. New dictionaries, terminological guides, scientific articles and expert discussions may be credible sources for a translator to verify the relevance of using a particular term on the topic of artificial intelligence in a certain context.

Although the mentioned sources contain some of the AI-related terminology, the field is developing dynamically which means that either the terms corresponding to new concepts have not been standardized in a particular language, or multiple terminological variations exist within one and the same concept. The problem translators are facing is to justify the use of a particular term or a terminological variation in a certain context without addressing the information resources, which do not contain this information. Furthermore, the usage of even currently standardized terms, for example in Ukrainian language, may be doubtful from the point of view of practical translation and create various difficulties caused by the excessive foreignization, confusion with the concepts taken from the other scientific fields, a loss of original meaning due to a different understanding of commonly established equivalents in the target language, etc. It means that whatever a dictionary or a scientific publication tells, a translator has to analyze multiple aspects of concepts related to the topic of artificial intelligence, search for the alternative designations, check the context of their usage in corpora or other credible sources, and motivate the choice selected for translation of a particular term.

Relevance. A challenge of this research is that AI-related content in Ukraine is introduced in English, as a rule, and it is quite hard to find the examples of parallel translation from English into Ukrainian, which does not allow one to compile a database of terms on the basis of comparison and frequency of use. Tech giant companies usually introduce a separate version of the website for every language, the content of which is either original or significantly localized, making any translation analysis irrelevant. However, by means of creating the concept model of AI features in English and Ukrainian, it is possible to match, compare, analyze particular terms and find out the cases of terminological variation with the followed-up guidelines for translation specialists on the basis of this empiric work. In this research, building the concept model as well as the terminological analysis are dedicated to identify the cases of terminological variation in the field of AI and to justify particular choices in translation from English into Ukrainian.

The field of artificial intelligence was chosen for analysis because it is one of the most powerful generators of world technology development, however, it often finds itself in need of linguistic

³ <https://developers.google.com/machine-learning/glossary>

⁴ <https://www.coe.int/en/web/artificial-intelligence/home>

⁵ <https://www.ipai.net.ua/en>

support due to a rapid tempo of new product developments. Without at least a basic understanding of translation terminology in this field, there is a big risk that the AI-related information in languages other than English will be either distorted or will not appear at all. Hence, there is a great need to translate the artificial intelligence-related terms in context. It is generally known that the use of terms in artificial intelligence is highly standardized and implies a search for accurate equivalents in translation. However, 1) Development of new technologies and business solutions caused the emergence of new realia, processes, and features applicable to the concepts under analysis, which might change the whole conceptual framework and, as a result, the term systems must be reviewed and updated; 2) There is a demand on studying the LSP terms in context due to the increasing variety of different information sources. Thus, production company websites, scientific publications, analytical reports, product user guides and policies, glossaries, and corpora may use terminology not in the same way, despite standardization, mostly focusing on particular thematic aspects. This fact can be justified by the use of certain “desirable” keywords while publishing the relevant scientific publications, customer information, or a patent – all types are focused on different target audiences and adapt to their readers. Also, it is important to draw the attention of translators to the strict lines between the terms which may sound similar but are used in different contexts and cannot be mutually exchanged as synonyms, nor is it acceptable to use the first found in a dictionary equivalent while translating these terms. For example, “AI-powered” is mostly related to a “model”, a certain invention that works on the basis of AI solutions, whereas “AI-driven” refers to the company or a service provider offering the AI technologies at the market. In the Ukrainian language, where these terms are used in a more descriptive manner, a translator will need to mind the nuances between “на основі штучного інтелекту” and “той, що використовує штучний інтелект”. Consequently, a translator can either study the difference in each particular case by investigating the field, which is time-taking and often requires the acquisition of a new profession, or use already elaborated sources in a particular, very specific technical field of study, which are often not updated and not relevant up to date, or analyze the contextual features of terms used in other translations, making up a decision which one should be used.

A **systematic review** of translation-oriented terminology studies has been done in order to synthesize the introduced approaches and findings in this field. Applying the method of systematic review while studying the approaches, it is decided to describe terminological variations according to the most relevant contextual perspectives (cognitive, communicative, discursive and diachronic) as well as to justify the motivation for using or not using particular variations in translation. **Ad hoc terminology work** is also applied to explain the terminological variations which occur in the process of translation from English into Ukrainian. A **contrastive analysis** of the concept components and terms is applied in order to contrast the English and Ukrainian artificial intelligence-related terminological units expressed within the use of modern languages. The analyzed English and Ukrainian terms are verified on the matter of use in context by means of **content analysis** (relational, qualitative).

1. Theoretical background of terminology systematization and translation

The chapter is dedicated to reviewing the research publications focused on studying translation-oriented terminology, analysis of terminological units in relation to concepts, and the use of terms in various types of contexts. The procedures of terminology work for translators are studied. The contextual features as the reasons for terminological variations are reviewed.

1.1. Basic terminological elements as the concept system representators

There are many different approaches to defining a term. Yet, the most of the scholars are tending to agree on the fact that a term or a terminological unit is a functional symbol applied in a specific field of knowledge, which is represented by a graphical, phonetical, and morphological forms as well as the meaning, that is a semantic reference to an object or phenomenon in the world. It is understood that terms, being the prototypical representations of concepts, unlike lexical units, should always belong to a certain linguistic environment, discourse, social domain, subject field or vocation. A term is a linguistic sign that correlates with the concept and subject of a certain professional field and on the basis of this relationship is part of a certain concept system as its integral element. This relationship should be understood as the “relationship” between a sign, a concept, and an object (Castellví, Sager & De Cesaris, p. 81, 1999; Fernández-Silva, Freixa Aymerich, and Cabré Castellví, p. 1-2, 2009; Kageura, p. 46–47, 2015; Shcherba, 2006, p. 239).

In terms of syntax, terminological units act like nouns in various grammatical structures of a certain language. A term may be represented by one-word designation, a multi-word designation, chemical or mathematical formula, scientific name in Latin or Greek, initialism (abbreviation made of the first letters of the term), acronym (abbreviation made of the first letters or syllables from each element of the term), appellation (such as official title, position, organization, administrative unit, names for official documents, etc.). Multi-word terms usually consist of a basic word element (a determinant) and one or several attributives, specifying or modifying the term’s meaning (Lušický & Wissik, 2015, p. 10-11; Sager, 1998, p. 43; Kitkauskienė, 2009, p. 53-54)

According to ISO 1087:2019, there are simple terms that consist of a single word or lexical unit, for example, “sound”, “light”, “barrier”, “accessory”, “accessorize”, “virus”, “viral” (simple terms include terms coined by derivation); single-word terms, for example, “cherry”, “ship”, “iron”, “barrier”; compound terms which are single-word terms that can be split morphologically into separate components, for example, “steamship”, “blackbird”, “afterbirth”; complex terms that consists of more than one word or lexical unit, for example, “computer mouse”, “fault recognition circuit”; and multi-word terms which are complex terms consisting of more than one word. The following types of terms are also distinguished: 1. A borrowed term – a term taken from another language or from another domain or subject; 2. Terminological neologism - term that is specifically coined for a given general concept; 3. Blended designation that is formed by clipping and combining two or more words; 4. Abbreviation – a designation that is formed by omitting parts from its full form and that represents the same concept; Abbreviations can be acronyms, initialisms or clipped terms; 4.1. Acronyms are made up of the initial letters of the components of the full form of a term or proper name or from syllables of the full form and that is pronounced syllabically; 4.2. Initialisms are made up of the initial letters of the components of the full form of a term or proper name or from syllables of the full form and that is pronounced letter by letter; 4.3. Clipped terms are made up of truncated terms. In accordance with the acceptability rating, that allows for designations to be placed in order

of preference as a guide to users, there are: 1. Preferred terms; 2. Admitted terms; 3. Deprecated terms; 4. Obsolete terms (ISO, 2019).

When normalizing terminology, the linguist has to solve a number of classification problems, determine, for example, the boundaries between terms and commonly used words, differences between terminological and general linguistic phraseology, between terms of the field of knowledge and lexical units of related fields, etc. Of particular importance is the division of signs of the terminological system into types, each of which requires a special approach in terms of normalization of terminology (Kyiak & Kamenska, 2008, p. 77)

Terminology experts generally agree clearly to discern objects, as the units of the real world, concepts, which are the units of thought, mental constructs introducing objects as well as consisting of a set of characteristics typical to a class of particular objects, and designations of concepts, which can be terms, names, symbols, etc. All these elements organize a structure of thoughts making communication possible. Concepts exist independently of terms which rather interpret than directly describe objects of the world. However, concepts are communicated linguistically via terms. A concept represents a totality of acts “firmly limited” by mental operations: thoughts or judgements (Sager, 1998, p. 42; Castellví, Sager & De Cesaris, 1999, p. 42; Valeontis and Mantzari, 2006, p. 1).

Accumulating the necessary fragment of knowledge and experience through the appropriate specific language form and becoming a reduced and communicatively sufficient sign of the denoted concept, terms acquire the functions of lexical language markers for special purposes, associated with ‘information peaks’ of sentences, microtext, professional text, discourse. The relations of concepts can be: hierarchical, which in turn are subdivided into generic and partitive relations and associative, or non-hierarchical. Hierarchical concepts are organized into levels where the superordinate concept is subdivided into at least one subordinate concept. Subordinate concepts at the same level and having the same criterion of subdivision are called coordinate concepts. The coordinate concepts resulting from the application of the same criterion of subdivision to the superordinate concept constitute a dimension. A superordinate concept can have more than one dimension, in which case the concept system is said to be multidimensional. Meanwhile, the associative relations exist when a thematic connection can be established between concepts by virtue of experience (Onufrienko, 2010, p. 168; ISO, 2000).

According to Biskub (2013, p. 13), every time a person receives a piece of new information about the world, this information tries to find a place in the brain by being assigned to one or another category. This applies equally to the assimilation of specific concepts and abstract concepts. Such processes in humans are clearly manifested in early childhood, when the child becomes acquainted with the world around. A special form of categorization is modeling (assimilation) of knowledge. This type of mental activity of a person unfolds throughout life and is characterized by an unconscious combination of categorization procedure with modeling, which is designed to generalize and integrate new knowledge into the information environment of a priori experience.

A structural difference between the conceptology and terminology is explained by Cabre (1998, p.43), emphasizing that while speakers are becoming “familiar with a special segment of the real world, they turn their knowledge into conceptual structure in which each concept occupies a specific place and acquires a functional value. Terminology thus is the basis for the structure of thematically specialized knowledge.” Speaking about the links between a term and a concept, according to

Depecker (2015, p. 40), a term consists of a linguistic part and a conceptual side denoting the idea it refers to. A designation is what a term is constructed from while being assigned to a certain concept. "Designation is used to describe a linguistic part of a term and is generally assumed to as a clearly mirror of a concept". So, a designation is understood as a representation of a concept embedded into language. Galinski and Budin (1993, p. 211) explain that some concepts may disappear, change over time or become generative for certain new concept systems with or without change of meaning. "These concept dynamics are not reflected and represented by the terms, which - as linguistic symbols - show much more stability than the concepts for which they stand." This creates a problem when slightly different concepts are associated with one and the same term which causes terminological variation.

According to ISO 704 :2000(E), "the terminology of a subject field is the collection of designations attributed to concepts making up the knowledge structure of the field. The concepts shall constitute a coherent concept system based on the relations established between concepts. A concept system serves to: model concept structures based on specialized knowledge of a field; clarify the relations between concepts; form the basis for a uniform and standardized terminology; facilitate the comparative analysis of concepts and designations across languages; facilitate the writing of definitions". The concept properties can be linguistically described by definitions. A definition can describe a concept as well as its links to other concepts, fixing the boundaries among them. The definitions can be intensional and extensional, according to the most widely used classification. Extension corresponds to the totality of objects to which a concept corresponds, whereas an intension is the set of characteristics which makes up the concept (Löckinger, Kockaert, & Budin, 2015, p. 62). In accordance with ISO 1087-1 2000, "an intensional definition is a definition which describes the intension of a concept by stating the superordinate concept and the delimiting characteristics. An extensional definition is description of a concept by enumerating all of its subordinate concepts under one criterion of subdivision."

Nuopponen (1994, p. 1072) mentions: "The concept of concept system, which is one of the most central theoretical notions in the theory of terminology, is usually defined in terminological literature as a system of related concepts which form a coherent whole. Starting from the idea of system, concept systems could be regarded as systems consisting of several components (concepts) and their relations (concept relations). They are mental, i.e. abstract, artificial, theoretical, man-made systems. They are static because they represent the conceptual apparatus reflecting the knowledge which exists at a particular time. New data result in new concepts, and the emergence of new concepts changes existing concept systems...". Thus, it is clear that the work of a terminologist is not finished as soon as a concept system is compiled for the reason that the concepts and relationships among them within the system may change. This is especially relevant for LSP terms in new fields of science, for example, artificial intelligence where the term formation is impacted by understanding of related concepts in different languages.

Shcherba (2006, p. 237) points out that a term is an element of a particular terminology. Moreover, scientists emphasize that it is an integral part of it or, in other words, can exist only as an element of this terminology. Therefore, the term is secondary to the concept system, which is, accordingly, primary. This idea is continued by Kochan (2013, p. 205-206), highlighting that since a term is a word of a special function, in each concept system it has its own, clearly defined meaning, although it can be created according to one model. The concept system of each branch of science or technology, reflecting a certain set of concepts of this branch, has self-systematizing properties and thus acts as a

systematizing factor for scientific concepts. The process of term formation is always aimed at streamlining and standardizing the concept systems. Certain specifics related to the process of nomination of scientific and technical concepts are outlined, where the function of the classifier of the concept, for example in Ukrainian language, is performed by suffixes, blocks (term elements), individual words in a phrase.

The concept systems are divided into: a) generic, in which all the concepts in a vertical series relate to each other as generic and specific concepts; b) partitive, in which all the concepts in a vertical series relate to each other as a whole and its parts; c) associative, in which all the concepts relate to each other by association. The type of associative relation between any two concepts may vary within a system; d) mixed, constructed using a combination of the concept relations (ISO, 2000). However, while defining the essence of concept systems Nuopponen (1994) adds: “It is often understood that concept systems are just strict logical hierarchies in which concepts are either superordinated or subordinated to each other. There are also other concept relationships and corresponding concept systems that need clarification in texts, e.g. temporal relationships referring to a process consisting of several stages, casual relationships, etc.”

Melby (2015, p. 427) believes that concept systems in specialized fields are the basis for the multilingual terminological resources, which should also include the use of terms in context. Madsen and Thomsen (2015, p.250) mention that concept systems include the description of the concepts mostly in the form of characteristics represented by, for example, attribute-value pairs and relationships within the subject field. A concept system, according to Nuopponen (2011, p.5-10), may be built by compiling a satellite model, which is a graphical mind map-like presentation based on concept analysis in mind with a core concept surrounded by other hierarchically connected concepts, and a concept relation model comprising concept relations and the information about the types of concepts. The second type may be a combination of models describing concepts by: 1. types and properties (basic); 2. composition and location (structure); 3. origination, development and processes; 4. activity; 5. transmission; 6. cause and effect; 7. dependence and comparison.

According to Kopitsa (2005, p. 123), terminological nomination, in contrast to language, is a purposeful creative process caused by the interaction of external and internal language factors. Models of terms and models of terminological phrases that differ in productivity and frequency can be built on the basis of terminological system connections in the terminology system. Popovych and Byalyk (2020, p. 207) mentioned that as a result of the processes of ordering, standardizing and systematizing terminology, its shortcomings are eliminated and a concept system appears - an ordered set of terms with fixed connections between them, reflecting the connections between term concepts. The concept system represents a fragment of the “scientific picture of the world”, characterized by such features as orderliness, relative completeness and accuracy in the designation of scientific, technical, professional concepts in a particular field. Since the concept system is consciously constructed from language units in the process of forming the provisions of a special theory or field of knowledge, or professional activity, the semantic structure of the concept system depends on the structure of this field of knowledge or activity and the theory that describes it.

Rogers (2004, p. 217-218) is emphasizing on the importance of modeling linguistic-conceptual mapping and identifying concept-concept relations within a system by translators when dealing with texts. The reason for it is a need of linguistic, semantic and conceptual contextualization of terms, especially technical, which is “a crosslinguistic lexical substitution exercise”. The objects of the world

can be reflected in the text so that only a full-fledged terminological analysis should be completed, because neither translation straightforwardly, nor even just concept identification can be enough for distinguishing those. This analysis mainly includes building the concept systems on the basis of either recording the expert talks, or studying authoritative texts. Finally, a coherent concept system may be used for establishing the multilingual equivalence of terms, including context. According to Kageura (1997, p. 119-120), the fundamental elements of a terminology-oriented concept systems are: “(1) a static organization of stable concepts represented by established terms and their inter-relationships and (2) dynamic potential for accommodating new concepts in the system, manifested by the rules governing the formation of new terms”. So, there is a certain set of basic concepts, which are supplemented by new ones in the process of expansion and remodeling.

Thus, term formation is subject to the rules prescribed in the relevant standards, being tightly connected with the concepts which correspond to a particular object or idea. The concept system is a multidimensional organization that consists of a number of interrelated concepts and defines the relationships between them. Modeling a concept system requires an in-depth analysis of terms that represent certain concepts via identifying their types, characteristics, and definitions. By modeling the concept systems, it is possible further to identify and to analyze the terms against a particular context for a multilingual analysis and translation.

1.2. Terminological variation and translation-oriented terminology

Gunnarson (1997) defines the language for specific purposes (LSP) as “*the traditional term for the various linguistic variants used in professional settings.*” When the texts of this type are translated from one language into another, it is necessary to distance from commonly established equivalents between the terms and, instead, to build interlinguistic references to the whole knowledge structures. Decision-making on multiple levels is contemplated by this process: the level of lexical unit (a particular term), the level of text and/or discourse (including the interculturality), and the level of background knowledge (expertise) while selecting a certain source or target knowledge system which is reflected in an LSP text. This article is focused on the analysis and processing of LSP multilingual terms and domain-specific knowledge for translation purposes (Gunnarson, 1997; Faber, 2009, p. 108).

Although the idea of specialized vocabulary standardizing receives general support, particularly due to the traditional prescriptive terminology backed by the Vienna School, which says that one concept should refer to one term and vice versa, and synonymy or polysemy should be avoided, there is another approach called descriptive terminology, describing the variations of terms within the social, communicative, cognitive and diachronic terminology studies. For example, Temmerman (2011) points out: “it has been shown that knowing cannot be separated from context, experience, culture, and language. Cognition is believed to be a dynamic and negotiable process in which the creative potential of language plays an important role...From a diachronic perspective, there is an interest in e.g. small variations of texts and discourse”. Depending on the communication context of terms, one concept may be expressed by multiple specialized terms. Those may differ from each other semantically, since various expert visions might be displayed within the concept. This difference should only be well-motivated and reflect the scientific vision of using a particular term. The dimensions of this vision are outlined in the subchapter 1.3 (Fernández-Silva, Freixa & Cabré 2009, p. 2).

The above-mentioned phenomenon when the terms denoting one and the same concept differ among each other is called terminological variation. Terminological variation is defined by Fernández-Silva, Freixa and Cabré (2009, p. 3) as “the use of alternative denominations to refer to the same concept...”. This is followed by minimal stability of lexicalized forms and a low level of consensus among the users of LSP units. It is emphasized that not only the formal side of the term can be affected (denominative variation), but the transformation of meaning may occur (conceptual variation) as a result of a particular concept perception by the recipient. Freixa (2006, p. 51-53) is distinguishing between “self-variation”, when “one and the same specialist may express the same idea, or name a concept, in different ways” and “hetero-variation”, when “different specialists may also express the same idea in different ways”.

Terminological variation is used in the translation of LSP texts in a specific communicative context sometimes preferred over another term found in a specialized dictionary. It is stated that terms in specialized dictionaries or databases should also contain contextual data on their possible use, and this would help practical translators at all stages of their work. Karremans (2010, p. 1-2;) mentions that “translators who need to translate a domain-specific text, consult specialized dictionaries to acquire a better understanding of particular concepts or the subject field, to familiarize themselves with the terminology and to look up possible translation equivalents of terms they encountered in their source text”. Terminological variation is especially frequent in reader-oriented texts, where the “author-reader” relationships play a key role. When a translator aims at disclosing all possible relationships between a source and a target text segment, very, from the first view, specific concepts might be translated in multiple ways (Gerzymisch-Arbogast, 2008, p. 41; Gambier, 2010, p. 412).

Two types of terminology are distinguished: theory-oriented terminology, which entails studying the relations between terms and concepts, concept formation, term formation, and standardization, and translation-oriented terminology, which refers to the type of terminology used by translators for translation purposes. Translation-oriented terminology can also be defined as “the kind of terminology work done by translators, either monolingually (in order to analyse the meaning of a term in the source language and/or the meaning of an equivalent term in the target language) or bilingually or multilingually (in order to compare the results of the monolingual analyses to see if there is equivalence between them), but always with a view to translation, where effectiveness and efficiency of the translation process and speed are most important.” (Thelen, 2015, p. 349) Considering the topic of entries, translation-oriented terminology contemplates that “... the minimum categories required in every collection of terminological information comprise the source language term, the target language equivalent, source information indicating where the terms came from, and a date with the initials of the person who made or updated the entry. There are, of course, many optional categories which may be added to the term record according to specific user needs.” (Eckmann, 1995, p. 4).

According to the newly revised International Organization for Standardization (ISO, 2021), “One of the most common scenarios for a terminology worker in translation contexts is the following: a client produces documentation in a particular subject field in a source language and asks a translator to translate a variety of interrelated documents. Since no terminology was provided, the translator recognises that it would be beneficial to document the terminology found during translation work to maintain consistency across documents in the target language.” The standard provides an example where it is confirmed that a translator needs to have basic skills in terminology work, conduct an analysis of terms that can be of different complexity, and be able to create as well as professionally

process certain term entries used in a particular translation project. “A *freelance translator who works on terminology for a patent translation project is the only active contributor to the TDC [terminological data collection] and the only user of the data. Although he does not do terminology work full time, he can have a very high level and broad set of terminology skills. And for certain concepts, he might need to do extensive research.*” The document provides such a workflow that a terminology database should be set up first. Once this is done, the next steps should follow: collection of terminological data, research, processing and documentation and use of terminological data, and maintenance.

The flow of terminological information recording and processing while working on translation projects is known as translation-oriented terminology management. Unlike following precise regulations of terminology work done by subject-field specialists, who unify, standardize, harmonize, and regulate terminologies, the task of translator is to perform ad-hoc terminology work exclusively with the purpose of translating an LSP text from a source into a target language. From this perspective, there is a high demand for modern comprehensive terminology systems providing precise information, and reliable knowledge available in a digital environment. However, since the terminology work has been done, translators usually prefer not to continue already undertaken research. This is why translation-oriented terminology management comprises the systematization and maintenance of terminology resources in order to prevent making mistakes in the future. At the same time, storing the properly complete terminological databases (for example, computer TMS datasets) may be helpful for subsequent translations of LSP texts (Galinski & Budin, 1993, p. 213-214; Vargas-Sierra, 2011, p. 50-51).

Martinez and Faber (2009, p. 92) highlight the need for translators to solve the issues of terminology in translation with the use of information management skills and even to prepare their own resources for it. The authors list the possible strategies which would help translators do their work appropriately, such as:

1. identification and understanding of specialized concepts in discourse;
2. evaluation, consultation, and creation of information resources;
3. specification of interlinguistic correspondences between terms in a specialized knowledge field;
4. data management for reuse in future translations.

In addition, the main activities for translation-oriented terminology work, which “can be performed in sequence or may also occur in loops during the translation and revision process” are outlined (Martinez & Faber, 2019, p. 248):

1. needs assessment and resource collection;
2. term extraction and term selection;
3. terminological research [concept and term description in the source and target languages, contrastive analysis, and documentation];
4. revision;
5. elaboration of terminological entries;
6. quality assurance;
7. maintenance;
8. dissemination.

On the stage of meaning determination of terms in two languages, it is required to complete the following (Thelen, 2013, p. 332):

1. look up the unknown item in a monolingual and bilingual (translation) dictionary;
2. analyze and compare the information given;
3. select (on the basis of this comparison) one equivalent from the bilingual dictionary;
4. use the equivalent found in the target language text;
5. check if the equivalent fits in the target language text, by (a.) looking up in a target language dictionary the equivalent found in step (1) and decided upon in step (3); (b.) checking the information given against the context of the target language text.

The quality of translation-oriented terminology management is also determined by the completion of the following activities (Vargas-Sierra, 2011, p. 50):

1. search for a given term more efficiently when compared to searching in printed dictionaries and other sources;
2. ensure the reliability of information retrieval, since terminological records are added and edited by translators on the basis of sources they trust, and on consultation with experts;
3. check how to use a term in context;
4. deal more efficiently with several languages;
5. store the solutions found for terminological problems to avoid duplicate research and unnecessary rework;
6. record multilingual domain-specific or in-house terms;
7. enlarge the database and then increase productivity during the ongoing translation or in a later translation;
8. systematize terminology;
9. use terminology consistently over the same or similar projects;
10. prevent mistakes or unsuitable usage of terms in a particular situation;
11. exchange terminological resources with colleagues, institutions, companies, etc.

In the English language, the attention is paid to supporting translators and interpreters, providing them with the terminology repositories in the field of AI based on building the concept models with the help of identifying relations among the concepts. However, with the development of AI, some of the concepts, ideas, and terms are still being reviewed, when there is already a demand on naming one or another object, phenomenon or event by a translator. Although the terminology work in the field of AI started back in the 60s of the last century in English-speaking countries, with the development of new technologies AI brought new aspects almost to all fields where it is applied. Also, considering such a high speed of development, it is quite difficult to introduce static definitions of certain concepts. There is not even a single definition of “artificial intelligence” as a term. This is why the AI-related terminological guides do not always reflect all the context and aspects in which a term is used. So, the translators need to work themselves looking up for connections between a concept and a definition, a term and an object or an idea. So, terminological variations may emerge when variable features of concepts are traced, such as a communicative situation, the context, purposes, experience and culture. There is a high demand on verifying the context-dependent variants in the field of AI and selecting the most relevant equivalents in a certain context (Massion, 2021, p. 90-104).

Ukrainian terminology science, including the terminology of artificial intelligence, is undergoing the process of development, considering the fact that the field itself has drawn the attention of researchers only recently. The importance of translating terms in the field of artificial intelligence is the consequence of a live dialogue between experts in various countries, and, due to these contacts, the Ukrainian language has to include new terms into its system. The problem of searching for national

equivalents and correct translations appears at all times, considering that development of AI is going further followed by the improvement of computer systems. A huge number of terms appeared in the period from 1990 to 2000, being compiled in the lexicographic works, however, many of such examples have lost their relevance today. A lot of authentic neologisms are included in the concept system of AI, which were accepted in terminological science according to the following scheme: authentic neologism – “spontaneous” term - standardized term. Most of the AI-related terms are multicomponent because even out of a single-component term it is possible to create a composite one of NN (noun-noun) type. In the process of interdisciplinary communication, term borrowing from the neighboring concept systems (logic, psychology, cybernetics, mathematics, coding) takes place, creating terminological variations at the discourse level. Step by step the borrowed terms are translated from English into Ukrainian, creating the situation when there is a foreign and a national term at the same time (Konovalova & Myroshnychenko, 2017, p. 134–135).

Thus, translation-oriented terminology is not a lighter version of scientific terminological management, since it comprises extra work with multilingual resources and establishing the links between two language systems. Moreover, research of context is an additional feature a translator has to focus on due to the unreliability of equivalence-based solutions in translation. From the perspective of context, the emergence of terminological variations may be the case demanding justification of use. Such cases as synonymy and polysemy, borrowed terms and neologisms in LSP can be the potential sources of terminological variation in the field of artificial intelligence, however, to trace these phenomena, it is necessary to build the concept models and to identify the relationships among the concepts which would show new gaps and other contexts in which a variant can be used.

1.3. Contextual features in translation as a reason for terminological variation

The descriptive terminology approach accepts the phenomenon of flexibility of concept formation depending on various contextual factors. In the same way, terminological units may entail variability on the semantic and formal levels (Fernandez Silva, Freixa & Cabre, 2009, p.4). As argued by House (2006, p. 343–344), from the perspective of recontextualization theory, which sets the task before translators to create a new discourse from the source text and to include the contextual connections in the target text, translation should consider such requirements to relationships set between text and context: 1. Source and target texts are assumed to belong to different contexts; 2. Contextual changes must be identified, described, and explained; 3. Contextual features of the source and target texts should be related to each other.

Terminological variation is prevalent in all fields of specialized communication. A term variant is related semantically and conceptually to the main term as an instance which can be activated in a particular situation. The selection of terminological variations depends on the context, which determines a semantic value and a pragmatic meaning. If a certain concept has specifications of a particular environment, it creates the use of contextualized lexical units. Such a concept is known as multidimensional, and this multidimensionality reveals terminological variation as a dynamic and a situated phenomenon (Tercedor, 2011, p. 183-184). According to Fernández-Silva and Karremans (2011), terminological (denominative) variation in specialized texts may occur when:

1. it is necessary to avoid using one and the same expression many times in order to follow an appropriate style of the target text;
2. it depends on a communicative situation, which particular message is the most rational for conveying the thought;

3. the levels of expertise among the communication participants are different;
4. an idea usually expressed by an established term is a little bit different from the idea meant by the speaker;
5. linguistic and sociocultural factors influence the formation of terms.

Karremans (2010) emphasizes that “translators who need to translate a domain-specific text, consult specialized dictionaries to acquire a better understanding of particular concepts or the subject field, to familiarize themselves with the terminology and to look up possible translation equivalents of terms they encountered in their source text.” Terminology variations are used in the translation of specialized texts in a specific communicative context, sometimes preferred over another term found in a specialized dictionary. It is stated that terms in specialized dictionaries or databases should also contain contextual data on their possible use, and this would help practical translators at all stages of their work. In this regard, one more reason for a terminological variation is the text coherence, which explains the deviations of terms in specialized texts from the traditional view when one term is referred to one concept. From the textual perspective, the units of understanding (UoU) are analyzed rather than concepts in order to identify “fuzziness and multiple ways of lexicalization in the text”. It is possible to define different lexical expressions, referring to one and the same UoU in the text. Terminological variants that refer to the same unit of understanding are called co-referents. As a result, the specific terms with a co-referential status can be defined on the basis of analysis. In this regard, UoU – is a unit of thought shaped via abstraction based on the characteristics of one or more objects. This term is used in socio-cognitive terminology, since the concept theory is considered to be restrictive and not always adequate for terminology in specialized domains (Temmerman, 1998).

The alternative denominations can be universally expressed through synonymy or polysemy. Terminological variation expressed through these phenomena have a crucial impact on any communication process. However, these units have a different level of relevance and applicability in various communicative situations and cannot be considered as complete synonyms (Cabr  Castellv  et al., 1999). Synonymy and polysemy within the same subject area create a variety of possible translation equivalents, which can sometimes prevent a translator from making the best choice. Even if a translator is well aware of which term is accepted in the target language for a particular case, preferable use of another synonymic equivalent can be supposed by the text due to pragmatic and denotation factors, as well as immediate linguistic context. According to Rogers (2004), “since translation decisions must take into account the behavior of potential equivalents in the TT [target text] context, as well as their relationship with terms in the ST [source text], it seems reasonable to assume that one TL [target language] synonym may be preferred over another TL synonym according to the linguistic context in the TT. In other words, equivalence needs to be established not only in terms of ST-TT relations but also in terms of TT [TL was meant] -TT relations.”

According to Kopitsa (2005, p. 125), significant groupings, or series of synonyms, are a reflection of the current state of development of the concept systems, while denotative series to some extent reflect the history of these systems. They present chronologically different terms to denote the same concept, some of which die out, while others remain functioning in language. On the one hand, in the process of continuous development of science and technology, with the emergence of new concepts and deepening knowledge of already known objects and phenomena of reality in the language of science intensifies term formation, which gives ample space for lexical duplication. On the other hand, scientific style, more than any other, requires clarity of names. In special vocabulary, synonyms arise both as a search for a more rational notation, and as a manifestation of their systematic nature in terms

of different schools and areas, and as a result of borrowing. Synonymy is especially characteristic of the initial stages of the formation of terminological systems, when there was still a natural (and artificial) selection of the best term from among a number of options. However, Gambier (2010, p. 412) assumes that due to the multiplication of synonyms and inaccurate concepts, there is a risk of having incoherent terminology. It is true that due to the various disciplinary backgrounds of scientists and the purpose of their research, terminological variation may appear. For a translator it means choosing a particular side, a strategy through which a certain meaning, format of presentation or an aspect is going to be introduced in the target text.

An important role in terminological variation is the loan concepts and lexical units. According to Onufrienko (2010, p. 169), the relationship between multilingual, in particular specific and foreign word-forming means that implement terminological categories can be qualified as asymmetric, as word-forming strategies are mostly national. Thus creation of interlingual analogues with similar semantics and motivation can be considered as a way of semi-hidden internationalization of vocabulary and terminology of languages which not only does not oppose the national, but also is embodied in it. The facts of borrowing another's word, adapting and using it as one's own (autochthonous) through assimilation, adaptation to one's paradigms outline the scale of real and potential power of the recipient language, which is manifested, dynamized, grows, strengthens if lexical borrowings demonstrate word-building potentials, creating a series of derived tokens and thus realizing multi-vector and multi-scale derivational connections in the word-forming nests of the corresponding terminology.

Neologisms in terminology work, according to Valeontis and Mantzari (2006, p. 13), are considered to be new terms shaped out from newly appeared concepts, which have a form of single-word lexical units used only for the first time in a particular language. The authors reject the idea that a neologism can be multi-word because blending lexical units means that those have already been used in other fields as one-word terms. Although, as it was mentioned by Roldan-Vendrell and Fernandez-Dominguez (2012, p. 10–16), terminological neologisms do not necessarily name new concepts but rather fill in the lexical gaps in the concept system. This phenomenon is called “a complementary neologism” by the authors, which refers to a new lexical item having a purpose not to name a new idea but to fill the lexical gap created by another neologism where the last one is limited to do so. There can be relations, for example, between a hyperonym and a hyponym or when a process in some special field is named but an action performed within this process requires using a new term.

In general, contextual factors causing terminological variation can be expressed through different dimensions:

1. A cognitive level, based on an expert's opinion which defines the characteristics of mental constructs;
2. A communicative level which considers the environment of message production and reception;
3. A discourse level, demonstrating the transformation of terms into the context-conditioned variants, when they were placed in a discursive environment.
4. A diachronic dimension, providing that “the concepts move from disciplines to disciplines over time, and are borrowed by various sciences, undergoing changes in the process...”. For translation it means that the term choice will depend on conceptual characteristics and contextual features of a term in a source text (Fernández-Silva and Karremans, 2011; Dury, 2005).

From the cognitive perspective, “Cognition is believed to be a dynamic and negotiable process in which the creative potential of language plays an important role...variation is often cognitively motivated” (Temmerman, 2011, p. 108). Fernández-Silva and Karremans (2011, p. 321) reported that “the cognitive level is related to the perspective from which an expert approaches the UoU in a particular situation, which will determine what features of the UoU the expert puts emphasis on”. According to Faber and Rodríguez (2009, p. 16), “the best way of studying the term behavior is in text...Understanding of a terminology-rich text requires knowledge in the domain, the concepts within it, the propositional relations within the text as well as the conceptual relations between the concepts in the domain”.

From the communicative perspective, “The degree of specialization of communication determines not only the terminological density of a text, but also the quantity of expressive variation for referring to the same concept. A highly specialized text is normally precise, concise and systematic; the terminology it uses tends towards monosemy and univocity. As the degree of specialization decreases, discourse acquires characteristics which bring it near to general discourse: at the semantic level, conceptual variation, redundancy, ambiguity, lack of strict precision; at a formal level, lexicon-based synonymical variation, but above all extensive use of paraphrases which explain analytically the same concept which, at a specialized level, is explained synthetically” (Freixa, 2006, p. 58). According to the communicative theory of terminology, terminological units are defined as “sets of conditions derived from, inter alia, their particular knowledge area, conceptual structure, meaning, lexical and syntactic structure and valence, as well as the communicative context of specialized discourse”. It is mentioned that a terminological unit includes three linked with each other dimensions: cognitive, linguistic, and communicative, and is defined by the general context of specialized communication (Faber, 2009, p. 114).

From the diachronic perspective, it is observed: “how the microscopic variations of terms in discourse affect the change of terminology over time or in the impact of metaphorical framing on term creation” (Tammerman, 2011, p. 108). According to Resche (1999, p. 619), “time can indeed affect terms and notions in different ways, changing either meaning or form or both and to various degrees”. It is mentioned that the meanings are fluctuating over time due to new fashion, lifestyles, findings, trends etc., and it is sometimes required to put the term back in its previous context while working with the old texts or vice versa, to update the definitions while working with the new texts. Dury (2005, p. 38) emphasized that diachronic terminology is especially relevant in translation work since a huge amount of scientific knowledge is exchanged among the countries and cultures. In order to ensure the correct interpretation of this knowledge, the history of terms and concepts should be considered in specialized translation as well as in terminology work. This can be done by illustrating the diachronic information in the form of hypertext and attaching it to the main body of the term definition in the corresponding sources.

From the discursive perspective, Fernández-Silva and Karremans (2011, p. 321) mention that “terms are subject to formal and structural transformations when embedded in a discursive environment, giving rise to different types of context-conditioned variants.” Fernández-Silva and others (2009) believe that “if we examine the behaviour of terms in real discourse, in relation to the context-related factors that could motivate term choice, we will be able to find out the patterns and regularities hidden behind such apparent randomness and provide a satisfactory explanation of the behaviour of denominative variation.” As Bowker (1998) mentions, term formation is directly associated with experts in the area who use the term in discourse. In a specialist community the terms may vary,

which is not a result of frivolity, since those skilled in the art mostly flesh out their expressions precisely and carefully enough. Instead, this phenomenon is based on a purpose or focus of communication in a particular discourse when, for example, some features of the concept are more important than the other.

In conclusion, all mentioned dimensions and perspectives of terminological variation should be considered in research of LSP terms used in context. However, the most relevant for technical language, where the terminology is highly standardized, are the contextual factors at cognitive and discourse levels. While working with a certain co-referent and picking up the term variant, a translator needs to keep in mind the motivation for such a kind of selection and be able to justify the choice made. Despite this fact, various aspects of dimensions should be kept in mind since every field of knowledge, science, or activity undergoes changes in the process of development leading to inevitable change of concepts, and, as it was outlined, an organized set of concepts named as a concept system directly impacts the process of term formation. The purpose of a particular message and the recipient should also be considered during the translation, because even the same term taken from one thematic area can be used with different goals, for example, providing general information, marketing, describing technical characteristics.

2. Practical analysis of terminology on the topic of artificial intelligence in bilingual resources and translations from English into Ukrainian

Chapter 2 is dedicated to identifying variable terminology in the field of artificial intelligence on the basis of the English and Ukrainian language systems. The subchapter 2.1. Methodology explains the procedure and relevance of search, comparative and content analysis of the terms used in translation from English into Ukrainian and in a certain context. In subchapter 2.2 “A satellite artificial intelligence-related concept model in modern English and Ukrainian languages”, the concept model for both languages is built where the reviewed concepts are being analyzed from the point of view of contextual features in two languages. Subchapter 2.3. “The analysis of artificial intelligence-related terminological variations in translation from English into Ukrainian” is focused on reviewing the AI-related terms and terminological variations on the basis of particular examples in translation from English into Ukrainian. The relevance of picking up a particular term or its variation is explained, considering the contextual features of the terminological unit present in both or one of the analyzed languages.

2.1. Methodology

Before conducting the analysis of terminological variations in the field of artificial intelligence, it is decided, on the basis of findings revealed in the theoretical part, to build a satellite concept model for identifying the fundamental concepts and the relationships among them in English and Ukrainian. Such a satellite model includes the core concept along with characteristics and relations to the other concepts with an indication of their types. The idea of the basic model by Nuopponen (2011) is being used as the sample for introducing the main information about the main notions of “artificial intelligence”. This model contemplates the presence of a core concept related to other concepts by the relations of generic subordination, generic coordination, generic superordination, and the characteristics of the object of reference. The latest have been extracted from multiple definitions of the term “artificial intelligence”, since there is not a commonly established one definition, and contrasted within the systems of the English and Ukrainian languages. The same concepts in different concept systems may have a different composition of characteristics and nature of relations with the other concepts. Classifying these characteristics helps a terminologist identify the affiliation of other concepts to a certain type in a particular language, which would later contribute to revealing terminological variations and the reason for their emergence.

The concepts related to AI and their definitions are provided using the information sources represented by dictionaries, terminological guides, reports, publications on professional websites, etc. Totally, 48 concepts, 24 in English and 24 in Ukrainian, are collected, analyzed, grouped, and compared against each other in the subchapter 2.2. A satellite artificial intelligence-related concept model in modern English and Ukrainian languages. When comparing the concepts of one layer (superordination, coordination, subordination, properties) in one language with those in another and trying to match those concepts with each other, the gaps in understanding certain aspects of particular objects and phenomena leading to the missed elements in the definitions of some terms are revealed. These gaps may be a reason for the emergence of various contextual features in a text causing multiple terminological variations which should be kept in mind during translation. Furthermore, a comparative analysis of concepts within the same thematic field in English and Ukrainian made it possible to find out a new portion of terms related to the field, and further to include them in a database. The method of grouping the English and Ukrainian concepts in pairs has been utilized to

reveal the field of related terms for research. There is no goal to build a full-fledged concept system of AI in two languages, instead the effort is paid to define the concepts which may be a potential source of terminological variations in both languages. Thus, in this research, revealed aspects of the analyzed concepts contribute to identifying other related concepts which may be affected by terminological variation within the thematic field of “artificial intelligence”. This is why various aspects of a concept representation are introduced in the analysis, including the specifics of understanding objects or ideas in a certain language. Also, the points of consideration for translation practice are outlined at this stage, since the concepts are reflected in certain designations which are analyzed against different contexts. These contexts may include different aspects embedded in the understanding of one and the same concept in two languages, called cognitive features, different scientific experience of interpreting the same concepts, technological progress reflected in the languages under analysis, leading to different levels of expertise in explaining the concept, etc. Furthermore, certain concepts can be expressed in languages by different designations with a specific grammatical, lexical or stylistic structure that should be considered in terminology work and translation of specialized technical texts.

On the basis of the introduced concept model, specialized terms in the field of ‘artificial intelligence’ and means of their expression in languages (grammatical, lexical, stylistic) along with the variations used in a particular context are analyzed and followed by the examples in translation. In those cases when translation examples have not been found, separate sentences in English and in Ukrainian containing one and the same term or a terminological variation are introduced and compared in the sense of terminology use. Both types of examples are retrieved from the information resource “Wikipedia” (<https://www.wikipedia.org/>) but the relevance of using certain terms, variations as well as the quality of translation were evaluated relying on collected theoretical material represented in Part 1. Selecting this particular resource for the analysis of terms in translation and in context is justified by the availability of two versions for the articles in Wikipedia: English and Ukrainian, which is not a feature of scientific articles usually written in one language. Totally, 80 terms, 40 in English and 40 in Ukrainian as well as 35 terminological variations in English and 40 terminological variations in Ukrainian are collected. So, in general, 155 terminological units are described and explained from the perspective of translation-oriented terminology. The usage of the selected terms in source and target languages are also compared, the differences are found, and the influence of this difference is considered while concluding whether a commonly established term or its alternative variation should be used in the example. The relevance of applying terminological variations in the field of artificial intelligence in English and Ukrainian is explained based on the contextual features and dimensions covered in the subchapter 1.3. Contextual features in translation as a reason for terminological variation. Various cases of using terminological variations have been revealed when, for example, they appear in both languages, either only in English, or in Ukrainian. The reasons for each of the mentioned cases is provided based on a comparative analysis of contextual features used in both languages.

Finally, before making a conclusion if a particular terminological variation can be used in a certain context as well as on the preference of using a certain term over another one, various examples of using the terms in context have been reviewed. When this content analysis shows the tendency of using a particular term mostly in the environment characterized by cognitive, communicative, discourse or diachronic limits, it is decided that the term is attributed with certain contextual features and that its variations can be used in a different environment. The introduction of all possible options

for utilizing particular terms, with the indication of causes of variation, can potentially be valuable for translation-oriented terminology guidance in the field of ‘artificial intelligence’, therefore the recommendations are given for translators on how to avoid confusion while dealing with, at the first glance, synonymous terms.

2.2. A satellite artificial intelligence-related concept model expressed in modern English and Ukrainian languages

For building a satellite model related to the core concept of “artificial intelligence”, it is first necessary to provide the definitions of this phenomenon from multiple sources in the English and Ukrainian languages. Then, it is possible to extract particular concept characteristics from these definitions and to compare them to each other in both languages. Finally, in this subchapter the concepts at the levels of superordination, coordination, and subordination are compared and matched against each other, providing contextual information for the future terminological analysis.

2.2.1. Property relationships for the concept of “artificial intelligence” in English and Ukrainian

It is important to mention that there is not one commonly established definition of “artificial intelligence” in the scientific community, so some of the most popular definitions are provided below. Moreover, interpretation of the analyzed core concept in English and Ukrainian differs from each other, probably, due to the fact that research in this field sets different goals in the English-speaking countries, where the AI was invented, and in Ukraine, where the AI-based technologies are underdeveloped and not so widely used.

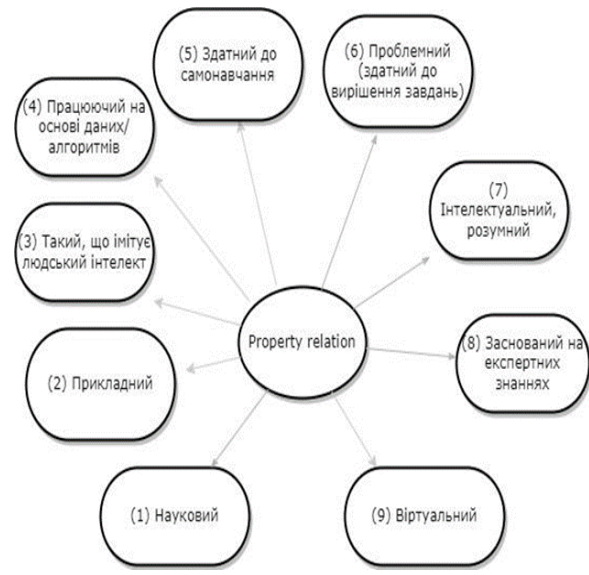
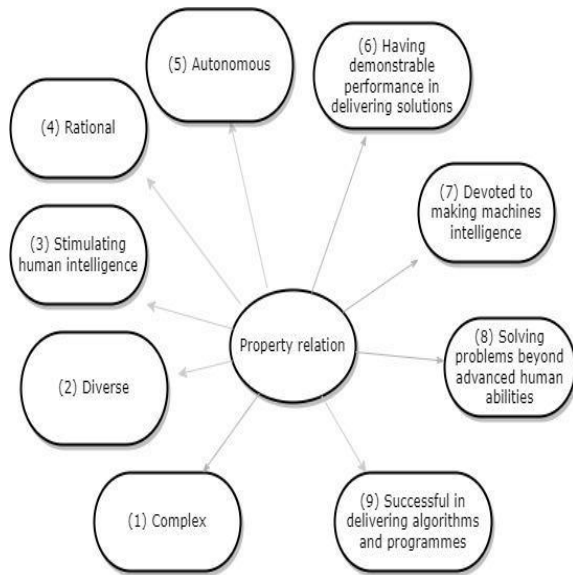
According to Laplante’s Dictionary of computer science, engineering and technology (2017, p. 23), artificial intelligence is “the study of computer techniques that emulate aspects of human intelligence, such as speech recognition, logical inference, and ability to reason from partial information”. Yet in another source (Akerkar, 2019, p. 3-4), “AI refers to manifold tools and technologies that can be combined in diverse ways to sense, cognize and perform with the ability to learn from experience and adapt over time”. The tools of sense comprise computer vision and media processing, cognition includes natural language processing and knowledge representation, and performance consists of machine learning and knowledge based systems. According to the “Microsoft” inventors (Azure Architecture Center, 2022), AI is “the capability of a computer to imitate intelligent human behavior. Through AI, machines can analyze images, comprehend speech, interact in natural ways, and make predictions using data”. A different source (Ranschaert, Morozov & Algra, 2019, p. 349) mentions that the “artificial intelligence (or machine intelligence) refers to systems that display intelligent behavior by analyzing their environment and taking actions - with some degree of autonomy - to achieve specific goals. AI-based systems can be purely software-based, acting in the virtual world (e.g., voice assistants, image analysis software, search engines, speech and face recognition systems) or AI can be embedded in hardware devices (e.g., advanced robots, autonomous cars, drones, or Internet of Things applications)”. By another definition, “AI is a science that’s used to construct intelligence using hardware and software solutions” (Nagy, 2018, p. 2).

Ukrainian Explanatory Ontographic Dictionary of Knowledge Engineering [Палагін О. В. & Петренко М. Г. Тлумачний онтографічний словник з інженерії знань] (2017, p. 92) provides the following definitions of artificial intelligence:

1. One of the areas of computer science, which aims to develop computer systems capable of performing functions traditionally considered intelligent: language comprehension, inference, use of accumulated knowledge, pattern recognition, learning, action planning, etc.
2. A scientific field in which the tasks of hardware or software modeling of those human activities that are traditionally considered intellectual are set and solved.
3. Scientific field connected with creation on the basis of computer facilities, means of great data volumes' processing and development of the solutions to certain practical problems on the basis of human organs of perception and/or algorithms. Examples of the use of artificial intelligence are "expert systems", "intelligent systems" and "computer vision".
4. One of the areas of computer science, the purpose of which is to develop hardware and software tools that allow the non-programmer user to set and solve intellectual problems in their subject area, communicating with a computer using language close to the natural language.
5. The property of intelligent systems to perform (creative) functions, traditionally considered the prerogative of humans.
6. A branch of computer science concerned with the imitation of human thinking by means of a computer, in particular, reflection, learning, and self-improvement.
7. The discipline that investigates the patterns underlying intelligent behavior by constructing and studying the artifacts that cause those patterns.
8. An algorithm for solving creative problems generated by artificial consciousness.

When analyzing the definitions of AI in scientific sources, it's possible to establish the property relations of the core concept, to separate the delimiting characteristics and to compare these characteristics with each other in both languages. The concept analysis of these characteristics may help a translator realize a general strategy of coining terms within the field of each particular language. This may also contribute to understanding why terminological variations can be expressed for a particular term in one language and, at the same time, not be present in another language. Also, the differences of definition characteristics may explain why a certain set of concepts became a basis for the terms in one language, whereas in another language a different set of concepts constituted the same terms. Considering the definitions of "artificial intelligence" mentioned above, the set of corresponding characteristics was defined (see Fig. 1 and Fig. 2).

Comparing the defined characteristics in two analyzed languages against each other provides the context in which the core concept exists within the concept system of a particular language and the difference of understanding the core concept from the perspectives of both languages. By analyzing the concept characteristics, the environment of the core concept shows up, allowing a translator to verify the fields of application and to make a decision which terminological variation would potentially be the best fit in a certain context.



1. Scientific; 2. Applied; 3. Imitating human intelligence; 4. Data-/algorithm-based; 5. Capable of self-learning; 6. Problem solving; 7. Intelligent; 8. Based on expert knowledge; 9. Virtual

Fig. 1. Property relations of the concept “Artificial Intelligence” in the English language

Fig. 2. Property relations of the concept “Artificial Intelligence” in the Ukrainian language

Comparing the English and Ukrainian sets of characteristics illustrated in Fig. 1 and Fig. 2, it is possible to distinguish the binary concepts, explaining the properties of artificial intelligence but from slightly different angles. Thus, the term “artificial intelligence” is described in English as “complex” (1) and in Ukrainian as “scientific” (1), which indicates about a certain level of complexity in both cases, but practice-oriented in the first case and theory-oriented in the second one. This may be explained by the fact that in the English speaking countries artificial intelligence is being actively implemented, whereas in Ukraine it is just being researched and studied. The English concept “diverse” (2) corresponds to the Ukrainian “applied” (2), since in the English-language sources there is an understanding of multiple opportunities to integrate AI solutions, while in Ukrainian sources it is observed how these solutions can be applied in existing products. The English “simulating human intelligence” (3) fully corresponds to the Ukrainian counterpart “imitating human intelligence” (3), proving that there is a common understanding of the concept in this field from the perspectives of both languages.

A more generic English concept “rational” (4) corresponds to a more specific Ukrainian “data-/algorithm-based” (4) due to the tendency scientifically to explain the phenomenon in Ukrainian literature. “Autonomous” (5) in English is also more generic than the Ukrainian “capable of self-learning” (5) but both concepts are related to a certain level of self-sufficiency. The English property “having demonstrable performance in delivering solutions” (6) matches the Ukrainian ‘problem solving’ (6), where the both concepts imply the ability of artificial intelligence to do the complex tasks, although the English concept is more focused on realizing an exact solution whereas the Ukrainian concept shows up the problem which must be solved. Artificial intelligence is also characterized in English as “devoted to making machines intelligent” (7) corresponding to just “intelligent, smart” (7) in Ukrainian. This demonstrates the difference of perception in a similar way as between developers and users, since the English concept explains the reason for being intelligent

more in detail. The English concept of “solving problems beyond advanced human abilities” (8) corresponds to the Ukrainian concept “based on expert knowledge” (8), illustrating an aspiration to create sophisticated solutions for artificial intelligence-based technologies to help humanity from the English perspective on the one hand, and quite an exaggerated understanding of intelligent technologies based on artificial intelligence as perfectly executed in the Ukrainian context. Although, the system may be considered as AI-based if only it relies on expert systems. Finally, such property of artificial intelligence in English as “successful in delivering algorithms and programmes” (9) conventionally matches the Ukrainian concept “virtual” (9), which reveals the focus on how the artificial intelligence works behind the scene in the English language and just the essence of this phenomenon that basically explains it in the Ukrainian language.

The analysis of characteristics retrieved from the definitions of “artificial intelligence” in two languages is helpful for determining the causes for terminological variations of the derivative from AI terms. For example, the observed focus on scientific explanation rather than on technical solutions in the Ukrainian language results in multiplying scientific terms denoting one and the same object or phenomenon but from slightly different perspectives, such as “кластеризація” (*clusterization*) and “кластерний аналіз” (*cluster analysis*). In another aspect, there is a difference in research goals, namely striving to create strong artificial intelligence (capable of solving multiple complex tasks) in the English-language sources and just studying the existing solutions in the Ukrainian-language sources. As a result, multiple terms denoting “superintelligence” appear in the Ukrainian language: “суперінтелект”, “гіперінтелект”, “надлюдський інтелект”, and multiple terminological variations concerning the mind of machines can be observed in the English language: “artificial consciousness”, “machine consciousness”, “synthetic consciousness”, etc.

2.2.2. The basic model of artificial intelligence-related concepts

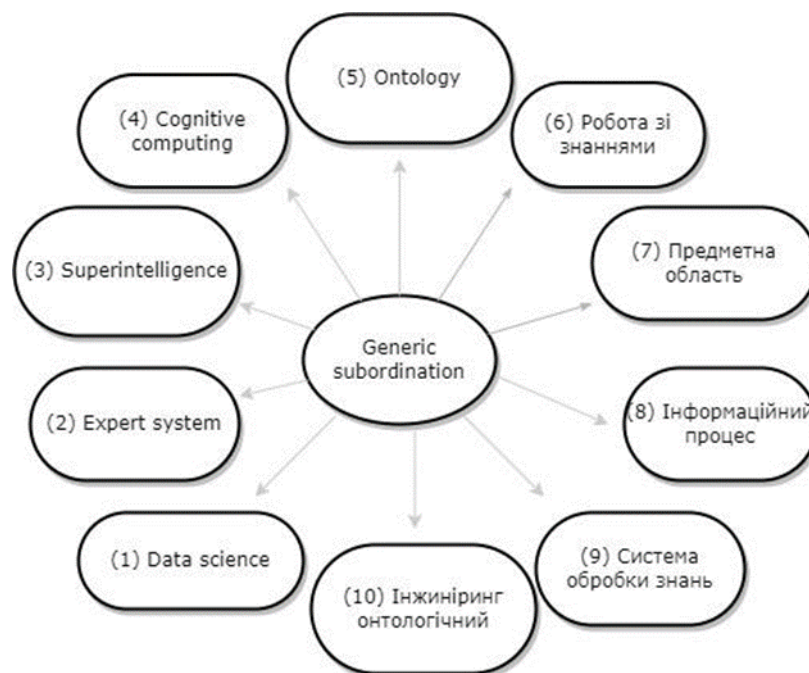
Another way for identifying differences of understanding the AI in two languages is building the basic concept model showing the interaction of the core concept with the other types of concepts. Revealing these differences allows determining the concepts which might be the background for terminological variation. This, in turn, creates a possibility to justify picking up one or another term, depending on the context, in the process of translating texts on the topic of AI from English into Ukrainian. Such concept analysis may become helpful for a translator at the initial stage of terminology work, since it allows one to determine the possible discourses, thematic fields, cognitive characteristics, such as various insights in different languages within one term, etymological and diachronic characteristics of concepts and related terms, semantic aspects, such as the shift of meaning, pragmatic aspects, such as communicative intentions, as well as translation and localization strategies based on the most commonly accepted concepts in a certain locale for a certain field.

The core concept of “Artificial Intelligence” is analyzed in two languages, and the related concepts of the satellite model are compared. English translation and the definition to the concepts under each diagram of the Ukrainian-language satellite model are provided, the numbering corresponds to the graphs.

In the dimension of generic subordination, that is, according to Nuopponen (2011), superordinate concepts to which the “artificial intelligence” belongs, the English and Ukrainian models are quite different: while the English one includes the production-related concepts, being focused on practical implementation of technology, the Ukrainian one is based on theoretical knowledge preceding or

standing “higher” in the hierarchy than the artificial intelligence”. It is possible to state that the superordinate concepts of the English model are generic towards the corresponding Ukrainian concepts, in the same way as the English concepts tend to be machine-oriented whereas the Ukrainian concepts are more human-oriented. Each of the English language concepts linked to the core concept of “artificial intelligence” by generic subordination relationships, which are illustrated in Fig. 3, implicitly matches the Ukrainian language concepts, linked to the same core concept by the same kind of relationships, starting from the numerical (6).

The concept of “Data science” (1) meaning the use of statistical methods encased in a blanket of data preparation and visualization techniques (Defense Science and Technology Laboratory, 2019, p.13) implicitly corresponds to the concepts “Робота зі знаннями” (6; Knowledge information processing). In certain contexts, a data scientist can be any specialist in statistical methods or generally in computer science, therefore in some types of translation it may be desirable to indicate the field of specialization. Since the field of data science is quite new and yet not very well studied in Ukraine, it is substituted by “Knowledge information processing” on the conceptual level, a process that involves the extraction and acquisition of knowledge, the presentation and manipulation of knowledge (Palagin and Petrenko, 2017, p. 104-106). In certain contexts, a knowledge source may be textual, graphic or audial, which should be considered in translation. In the same way, knowledge information processing must not be mixed up with data processing, since data can be unorganized and not provide any new information.



6. Knowledge information processing; 7. Subject domain; 8. Information process; 9. Knowledge processing system; 10. Ontology engineering.

Fig. 3. Generic subordination relationships of the superordinate concepts and the core concept “Artificial Intelligence”

The concept of “Expert systems” (2), denoting systems using rules to provide advice and guidance (DSTI, p. 11) in English, implicitly corresponds to the concept “Предметна область” (7; Subject area) in Ukrainian. In certain contexts, expert systems with the knowledge represented in rule form are called rule-based systems. The Ukrainian-language concept is defined as a specific area of human

activity, which includes a set of tasks for users. At the same time, the concept “Предметна область” (*subject area*) has a variation “Прикладна область” (*application domain*) which is sometimes used as a synonym, however, being more relevant when it goes about a very specific technological solution (Palagin & Petrenko, 2017, p. 95-96).

The concept of “Superintelligence” (3) in the English language, indicating that AI possesses all human cognitive ability and its intelligence is able to overpass human in many aspects (United Nations, 2020, p. 129), implicitly corresponds to the concept “Інформаційний процес” (8; Information process) in Ukrainian. In certain contexts, when it needs to be specified, there appears a variation Artificial super intelligence (ASI). The Ukrainian-language concept is defined as the process of perception, accumulation, processing, and transmission of information (Palagin & Petrenko, 2017, p. 95-104). These parallels indicate that in the Ukrainian context super intelligence has not been viewed as a goal of current research or as an achievable task in a short-term perspective, instead possible dimensions of work with information are used as the elements of a superordinate concept.

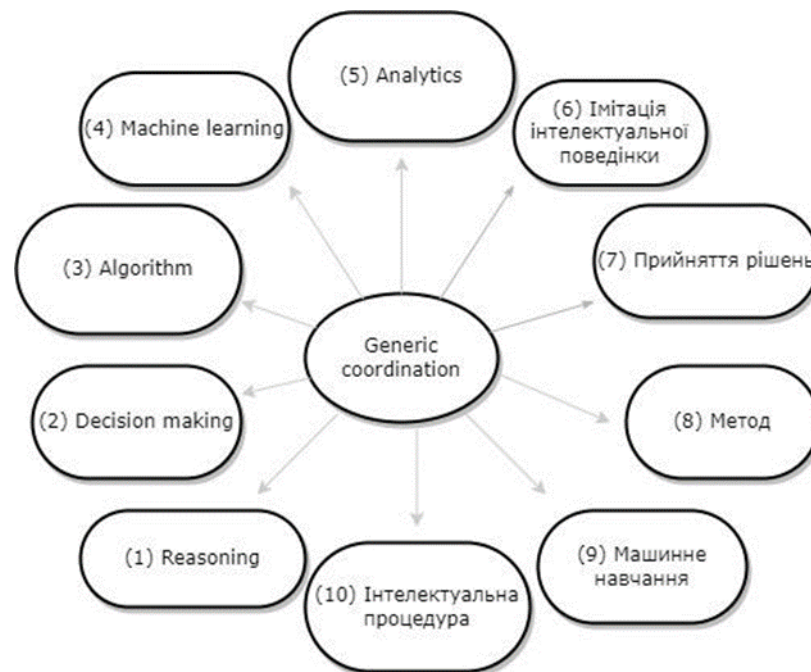
The concept of “Cognitive computing” (4) in the English language, which is applying knowledge from cognitive science to build systems that simulate human thought processes (Johnes, 2018, p.11), implicitly matches the concept 3 “Система обробки знань” (9; Knowledge processing system) in the Ukrainian language. In certain contexts, cognitive computing covers several disciplines, including machine learning, natural language processing, vision, and human-computer interaction, so a translator should not only know the term but also the subject field for quality translation. The Ukrainian-language concept is defined as any intelligent information system that manipulates knowledge (Palagin & Petrenko, 2017, p. 103-129), which in certain contexts may include the aspects allowing an AI-based system to adapt to internal and external environment, to realize thinking and action algorithms, to manage the processes of task solving by following a model, etc. This match indicates that both concepts include several fields of knowledge vital for the proper functioning of artificial intelligence solutions, however, the Ukrainian perception of this concept is more focused on working with knowledge, whereas the English concept extrapolates to a separate discipline studying those fields.

The concept of “Ontology” (5) in the English language, referring to formal descriptions of topic areas, enabling machines to make more sense of data about those topics (Defense Science and Technology Laboratory, 2019, p. 11), implicitly corresponds to the concept “Онтологічний інжиніринг” (10; Ontology engineering), which is a borrowed term used simultaneously with a more native to Ukrainian language “Онтологічна інженерія”, denoting the section of knowledge engineering, a new direction in the methodology of developing knowledge processing systems, based on formalized methods of constructing ontological descriptions of subject areas and their use. (Palagin & Petrenko, 2017, p. 106). So, both concepts include processing the topic/subject areas for the sake of using this knowledge by a machine, however, the English concept is more generic whereas the Ukrainian one describes a particular science due to the already mentioned shift of focus to the scientific explanation of the analyzed phenomena.

In the dimension of generic coordination, that is, according to Nuopponen (2011), the number of objects which belong to the same group or class, the coordinate concepts of “artificial intelligence” have a fuzzy correspondence compared to each other, although the same abstract objects match the mentioned concepts. The related English and Ukrainian concepts linked to the core concept of “artificial intelligence” by generic coordination, are illustrated in Fig. 4 and are implicitly matched

as well as compared to each other. It is important to mention a higher level of coincidence among the coordinate concepts than among the superordinate, because the fields related to AI are science-based and just came into Ukrainian from English. However, some of the English concepts are more specific and technically-oriented than the Ukrainian ones, exactly as in the case with generic subordination.

The English concept of “Reasoning” (1), meaning making inferences, planning and scheduling activities, searching through a large solution set, and optimizing among all possible solutions to a problem (The European Commission’s High-Level Expert Group on Artificial Intelligence, 2018, p. 6). It implicitly corresponds to the Ukrainian concept of “Імітація інтелектуальної поведінки” (6; Intellectual behavior simulation), which denotes generating procedures for the formation of purposeful behavior of people and animals in the outside world, depending on the situations that occur in it, driven by special models and methods of activity planning (Palagin & Petrenko, 2017, p. 105). Both concepts stand close to each other and may include performing by a machine a set of model activities with the purpose of solving certain tasks, which at some level copies a human behavior and intellect. The first concept is more typical for the use in formal logic, and the second one - in cybernetics. Thus, when the coordinate concepts belong to different sciences, the related terms may also be variable due to the use in different discourses.



6. Intellectual behavior simulation; 7. Decision making; 8. Method; 9. Machine learning; 10. Intelligent procedure.

Fig. 4. Generic coordination relationships of the coordinate concepts and the core concept “Artificial Intelligence”

The concept of “Decision making” (2) in the English language has a definition of outputting an action to take, given the goal to achieve, from the input of data coming from the sensor (The European Commission’s High-Level Expert Group on Artificial Intelligence, 2018, p. 5), whereas the same Ukrainian concept “Прийняття рішень” (7; Decision making) is described as choosing the most acceptable option to achieve the goal from a set of acceptable alternatives (Palagin & Petrenko, 2017, p. 108). From this it can be concluded, that although the concept has one and the same designation in both languages, in English it is understood in a tight connection with the functionality of AI-based

solutions, when in Ukrainian this process is viewed as such that can be performed not only by a machine but by a data scientist, for example.

The English concept “Algorithm” (3), meaning a set of rules or instructions that require computer to follow to solve (United Nations, 2020, p. 119), implicitly matches the Ukrainian concept of “Метод” (8; Method), which is defined as an algorithmic procedure, set of algorithmic procedures or algorithmic scheme, which has the following properties: scope - a list of tasks that this method allows to solve, input and output data, a set of subtasks that need to be solved to implement this method (composite method), or some operator (simple or compound method) (Palagin & Petrenko, 2017, p. 135). Although the concept similarity is visible when analyzing this pair, the Ukrainian coordinate concept is generic to the English, a more specific one. This tendency is reflected in publications about artificial intelligence when the English sources are focused on specific elements and research of practical solutions, whereas the Ukrainian sources are generally describing the opportunities of AI.

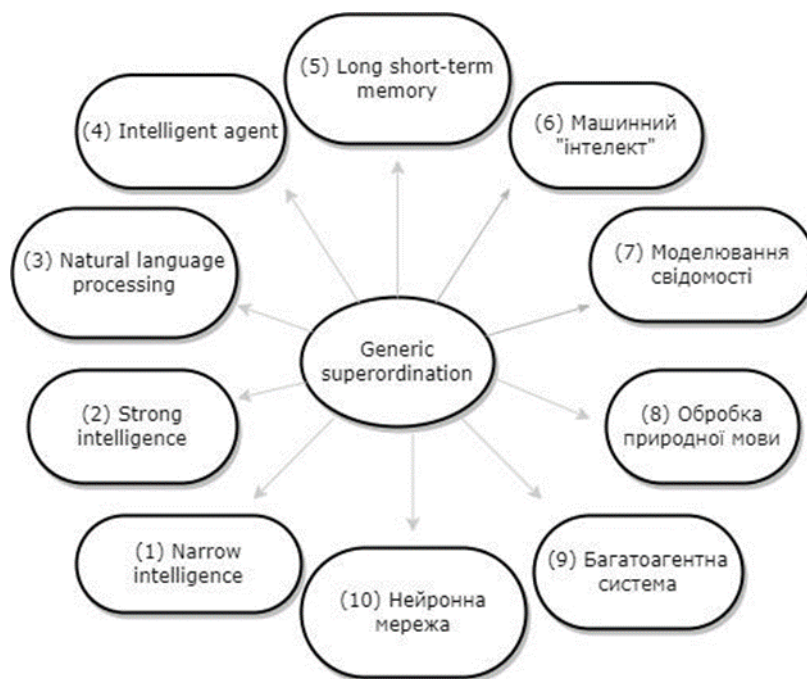
The concept of “Machine learning” (4) in the English language, denoting creation of systems able to automatically learn the relationships between input data and the classifications or actions one wants to happen without being explicitly programmed (Defense Science and Technology Laboratory, 2019, p. 21), fully corresponds to the Ukrainian concept of the satellite model “Машинне навчання” (9; Machine learning), which in Ukrainian context is defined as a scientific discipline related to the development of inductive derivation algorithms based on empirical data, their classification, detection of hidden patterns and knowledge formation (Ontology dictionary, p. 130). The same tendency as in the previous cases is observed here, when the English concept denotes a specific technical process definitely related to AI-solutions and showing a particular way of its implementation, whereas the Ukrainian concept attributes machine learning to a particular science which studies a wide spectrum of knowledge, without explaining the technological possibilities in the definition. This may result in the emergence of multiple, possibly variable, terms in the Ukrainian language related to machine learning in order to explain various practical aspects of this process.

Finally, the English concept of “Analytics” (5), meaning statistical analysis of specialized data in the AI (Defense Science and Technology Laboratory, 2019, p. 20), implicitly matches the Ukrainian concept of “Інтелектуальна процедура” (10, Intelligent procedure) which stands for a procedure solving the intellectual task or a sequence of operations (Palagin & Petrenko, 2017, p. 115). The match concerns primarily executing operations with data related to the work of AI, although both concepts are focused on performing quite different tasks. In the same way as previously, the English concept reveals a specific process with a practical goal to analyze data, whereas the Ukrainian concept generally includes various processes focused on different operations, although used in the context of AI.

In the dimension of generic superordination, that according to Nuopponen (2011) includes subtypes which the core concept has, the subordinate concepts of “artificial intelligence” in English and Ukrainian have both the accurate matches, when one and the same constitutive elements are reviewed, and the fuzzy matches, when the core concept is reviewed from the perspectives of either studying, or technical implementation. The related English and Ukrainian concepts linked to the core concept of “artificial intelligence” by generic superordination, are illustrated in Fig. 5 and are implicitly matched as well as compared to each other. The fuzzy matches are still grouped in pairs of the English and the Ukrainian concept due to common elements these concepts share with each other. Considering previously analyzed characteristics retrieved from the definitions of the core concept, superordinate

concepts which may belong to various fields of science, and coordinate concepts which may coincide in both languages but have a different set of cognitive aspects, it can be concluded that, due to the mentioned reasons, the subordinate concepts include terminological variations in both languages.

The English concept of “Narrow intelligence” (1), denoting AI that is focused on performing one main task (Defense Science and Technology Laboratory, 2019, p.10), implicitly corresponds to the Ukrainian concept of “Машинний інтелект” (6; Computer intelligence), comprising a set of characteristics of a computer, such as the stock of information in it and the ability to replenish it through learning, the degree of “understanding” of high-level programming languages, the degree of structural implementation of information processing methods and organization of the computing process as a whole (Palagin & Petrenko, 2017, p. 92). The reason for this match is that the concepts of “narrow intelligence” and “strong intelligence” are more frequently observed in the English sources, whereas in Ukrainian context the primary goal is to study the opportunities of already existing technological solutions without dividing AI into “narrow” and “strong”. The word “understanding” in the definition of “Computer intelligence” indicates a capacity by a machine to solve a certain task through manipulations with data and information and means that the currently existing systems do not possess “intelligence” in reality, although such an impression may appear. This is why, from the perspectives of cognition, “Computer intelligence” is a prerequisite for performing the minimal set of functions typical to “Narrow intelligence”.



6. Computer intelligence; 7. Mind simulation; 8. Natural language processing; 9. Multi-agent system; 10. Artificial neural network.

Fig. 5. Generic superordination relationships of the subordinate concepts and the core concept “Artificial Intelligence”

The concept of “Strong intelligence” (2) in the English language, making reference to machines that can perform many tasks, be cognitively aware of what they are doing and be able to self learn and adapt (Defense Science and Technology Laboratory, 2019, p. 10), implicitly matches the concept of “Моделювання свідомості” (7; Mind simulation) in the Ukrainian language, denoting a set of procedures and declarative descriptions by which intellectual systems simulate the part of conscious

human activity that is subject to verbalization (Palagin & Petrenko, 2017, p. 107). Exactly as in the previous analysis of the concept pair, “strong” intelligence belongs to research phenomena in the English-language specialized literature but is not paid enough attention in the Ukrainian discourse since this goal is hardly achievable in the current state of Ukrainian science. Instead, “mind simulation” as an aspect of strong intelligence is still considered on the conceptual level due to being, at least in part, close to the implementation in the current AI-based technologies.

The English concept of “Natural language processing” (3), meaning the application area for building models which understand natural language and are able to reason about it (Landgraf, 2021, p. 4), is a direct counterpart to the Ukrainian concept of “Обробка природної мови” (8; Natural language processing), which in Ukrainian context is understood as a set of processes for analyzing texts in natural language, their understanding and synthesis (Palagin & Petrenko, 2017, p. 374). Although the concept designations fully coincide in both languages, their understanding is slightly different since the English definition is based on a single notion referring to one technique, the Ukrainian definition refers to multiple processes. Such a difference can be a prerequisite for various interpretations of terms related to “natural language processing” in both languages.

The concept of “Intelligent agent” (4) in the English language, described as a discrete bit of code that interacts with other agents through a set of rules (Defense Science and Technology Laboratory, 2019, p. 12), implicitly corresponds to the concept of “Багатоагентна система” (9; Multi-agent system) in the Ukrainian language, being defined as a system formed by several interacting intelligent agents used to solve problems that cannot be solved with a single agent or a monolithic system (Palagin & Petrenko, 2017, p. 97). The obvious difference between these two subordinate concepts is that the English one refers to a single element within the system which is, however, determinative in functioning of an artificial intelligence-based system, whereas the Ukrainian concept covers the whole system of these elements crucial for the task completion by the system. It is supposed that with a focus on the structural system element there might be terminological variations to name the whole system in the English language, and, vice versa, with an emphasis on the whole system, there might be multiple terminological variations denoting the structural elements of this system in the Ukrainian language.

The English concept of “Long short-term memory” (5), meaning a type of deep network suited, not only for single data points, such as images or tabular data, but also sequences of data, such as video or speech (Defense Science and Technology Laboratory, 2019, p. 31), implicitly corresponds to the Ukrainian concept of “Нейронна мережа” (10; Artificial neural network), denoting a mathematical model, as well as its software or hardware implementation, built on the principle of organization and functioning of biological neural networks (Palagin & Petrenko, 2017, p. 100). Although from the first glance there is no match between two concepts it is possible to include an “artificial neural network” as a subordinate concept in the English-language satellite model, actually the “long short-term memory” is the artificial neural network with feedback connections which allows it to process sequences of data. Thus, the analyzed concept is covering the artificial neural networks and, at the same time, is focused on work with various modern types of data. Both concepts relate to operations in language processing, such as voice recognition and speaker identification, that might be a potential field for the use of terminological variations in both languages.

Although it may seem that a cursory study of a thematic field is enough for a translator in order to define the main terms and start directly working with a text, building a satellite concept model allows

one to conduct an in-depth bilingual analysis of the main concepts and complete the initial step of terminology work. This analysis helps a translator review the relationships among the selected concepts within the model as well as reveal the field of other related concepts which may correspond to the terms which would be relevant in a certain case of translation. While analyzing the concepts in two languages by means of comparative or contrastive analysis, it is possible to find a terminological variation in a target language which would be the most relevant according to the context.

2.3. The analysis of artificial intelligence-related terminological variations in translation from English into Ukrainian

Previously analyzed concepts can become a basis for the selection of related terms and their analysis in translation from English into Ukrainian on the matter of variability. Since the term “artificial intelligence” and the concepts related to it are frequently used in various settings, the contextual features are taken into consideration while doing the analysis of term translation. Totally, 80 terms, 40 in English and 40 in Ukrainian as well as 35 terminological variations in English and 40 terminological variations in Ukrainian are collected. So, in general, 155 terminological units are described and explained from the perspective of translation-oriented terminology. The examples of translation, including terms and variations, are taken from the web resource “Wikipedia”, since both English and Ukrainian versions are represented there, and evaluated considering the contextual features. It is necessary to mention that such parallel translation is often carried out, mostly addressing a lower level of awareness about the AI-based technologies among Ukrainian readers, so the sentences in Ukrainian version may simplify, omit, or transform certain information in the source text which seems to be overwhelming. When the parallel translations are not found, other examples of separate sentences in English and Ukrainian, containing a particular term and its variation, are collected from the scientific literature and media resources, making up a mini bilingual terminological corpus. The analysis of translation examples shows what contextual features influence the selection of a commonly established terminological unit or a terminological variation in the sentence.

2.3.1. Analysis of terminological units and their variations in translation from English into Ukrainian based on the superordinate concepts of “Artificial Intelligence”

While analyzing the superordinate concept pair “*Data science*” - “*Робота зі знаннями*” (*Knowledge information processing*), the terms *data mining*, *big data*, *dimensionality reduction*, *knowledge representation and reasoning*, and *semantic network* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics is explained.

The English sentence: “*The actual data mining task is the semi-automatic or automatic analysis of large quantities of data to extract previously unknown, interesting patterns such as groups of data records*” has a localized equivalent in the Ukrainian version: “*Добування даних - це процес напівавтоматичного аналізу великих баз даних з метою пошуку корисних фактів*”. As it can be observed, the commonly established term is used in both versions, although, *добування даних* is a kind of loan translation since as it will be illustrated below, the term is a buzzword, since the process concerns not actual extraction of data but the information from data. At the same time, since *data science* is not present in the Ukrainian satellite concept model (because this science is yet not very well known for readers) and there is a certain gap on the conceptual level, the terminological variation for *data mining* takes place in the Ukrainian language. In the following example *data mining* is

already translated as *глибинний аналіз*: “Глибинний аналіз даних здійснюється автоматично шляхом застосування методів математичної статистики, штучних нейронних мереж, теорії нечітких множин або генетичних алгоритмів”. There is a similar terminological variation in the English language as well, as in the following example: “Often the more general terms (*large scale*) *data analysis and analytics* - or, when referring to actual methods, *artificial intelligence and machine learning* - are more appropriate”. However, the English variable term, as it was mentioned, is a more generic term and cannot be considered as a full equivalent which may substitute the term *data mining* as in the case with Ukrainian. The terminological variation in the English language is caused by cognitive factors when the expert opinion motivates the selection of particular characteristics of a phenomenon. This is happening when the level of expertise among participants of communication excludes using the marketing term “data mining”, and instead, the idea conveys a large-scale information processing, not just data extraction. In the Ukrainian language, the emergence of variation is motivated by the necessity to explain a loan translation of *добування даних*, mostly used in non-expert communication, and its actual meaning. So, the variation is expressed on a discourse level, showing a transformation of this term in the expert environment where it is important to formally and accurately name the process.

Reviewing the term *big data*, the English sentence: “*Big data* refers to data sets that are too large or complex to be dealt with by traditional data-processing application software” has been translated into Ukrainian as “*Великі дані* - набори інформації настільки великих розмірів, що традиційні способи та підходи не можуть бути застосовані до них”. Exactly as in the previous example, the Ukrainian term *великі дані* is a loan translation which was, however, used first to refer to this new process in the IT industry and became a widely used term. When in the English language *big data* became a brand name and speakers in any field of expertise understand its meaning, the Ukrainian denomination in this case may cause misunderstanding concerning the amount of data meant, and the context is lost since one inexperienced in the state of the art may call big data just a big amount of any data. For this reason, sometimes the English lexical infiltration is used in the Ukrainian text to retain the accuracy of translation, as in the following example: “Медичні *big data* допомагають запобігти розвитку хвороби на ранній стадії завдяки аналізу серцево-судинного тиску, пульсу, дихання та рівня цукру в крові”. The variation here is expressed on a communicative level due to the impossibility to use the term “великі дані” in the Ukrainian language because of possible misinterpretation. This may be changed in future with the emergence of a new native term or by a single common understanding of the term *великі дані* only in this particular context.

The English term *dimensionality reduction* has an equivalent in the Ukrainian language *зменшення розмірності* which successfully describes the process without addressing any borrowings or neologisms. Thus, the English sentence: “The main linear technique for *dimensionality reduction*, principal component analysis, performs a linear mapping of the data to a lower-dimensional space in such a way that the variance of the data in the low-dimensional representation is maximized” is translated into Ukrainian as “Основна лінійна техніка *зменшення розмірності*, метод головних компонент, здійснює лінійне відображення даних в менш вимірний простір таким чином, що максимізується дисперсія даних у маловимірному представленні”. This translation from English into Ukrainian is done competently taking into account the context and the discourse of expert communication. However, one should be attentive when translating from Ukrainian into English, since the English term “dimensionality reduction”, which is used as a general term covering the whole process, has a variation *dimension reduction*, mostly used to describe a specific action which is

performed in each particular case. In the following example, the English sentence “*For high-dimensional datasets (i.e. with number of dimensions more than 10), dimension reduction is usually performed prior to applying a K-nearest neighbors algorithm in order to avoid the effects of the curse of dimensionality*” is translated into Ukrainian as “*Для багатовимірних наборів даних, тобто таких, у яких більше 10 вимірів, перед застосування методу k-найближчих сусідів спочатку знижують розмірність з метою уникнення прокляття розмірності*”. As it can be observed, the terminological variation *dimension reduction* is translated as a verbal phrase *знижують розмірність* since this case concerns a specific action.

The English term *knowledge representation and reasoning* also has two variations in the Ukrainian language: *представлення знань* and *подання знань*. The first one is a more commonly used standard term corresponding to “knowledge representation and reasoning” when it concerns the artificial intelligence systems without any references to other sciences. Thus, the respective term in the English sentence: “*Knowledge representation and reasoning is the field of artificial intelligence (AI) dedicated to representing information about the world in a form that a computer system can use to solve complex tasks such as diagnosing a medical condition or having a dialog in a natural language*” is localized into Ukrainian as “*У штучному інтелекті основна мета представлення знань — навчитися зберігати знання так, щоб програми могли опрацьовувати їх і досягати подібності з людським інтелектом*”. However, the diachronic analysis shows that the term came into Ukrainian language from “Теорія подання знань” (Theory of knowledge representation) in cognitive theory, so when it’s necessary to make a reference to knowledge taken from the cognitive field, the term *подання знань* is used. So, the Ukrainian sentence “*Дослідники штучного інтелекту використовують теорії подання знань з когнітології*” can be compared to the English sentence: “*These efforts led to the cognitive revolution in psychology and to the phase of AI focused on knowledge representation*”. It is noticeable that the part of the term “reasoning” is omitted in the English sentence, illustrating the reference to cognitive science from which the term was borrowed. So, the terminological variations are expressed at the diachronic level when in the English language “knowledge representation” from the cognitive science became “knowledge representation and reasoning” in the AI, and Ukrainian “Подання знань” from the cognitive science became “Представлення знань” in the AI. Nevertheless, also in the field of AI both variations are used almost synonymically, it is important to know the nuances for translators to avoid misunderstanding.

The English term *semantic network* has a terminological variation *frame network* the use of which should be carefully considered since technically frames may contain extra computing information for a system to process while semantic networks don’t have such capacity. The English sentence: “*Semantic network is a directed or undirected graph consisting of vertices, which represent concepts, and edges, which represent semantic relations between concepts, mapping or connecting semantic fields*” is localized into Ukrainian as “*Семантична мережа — інформаційна модель предметної області, що має вигляд орієнтованого графу, вершини якого відповідають об’єктам предметної області, а ребра задають відносини між ними*”. So, the commonly established terms are mostly used in the AI texts instead of variations. It is, however, important not to confuse the Ukrainian term *семантична мережа* with a similar one *семантична павутина* which shares the same characteristics but is built on hyperlinks instead of describing semantic relations.

While analyzing the superordinate concept pair “*Expert system*” - “*Предметна область*” (*Subject area*), the terms *forward chaining*, *backward chaining*, and *automated theorem proving* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics

are explained. As the term, *предметна область* in the Ukrainian language has also a variation *прикладна область*, both are commonly used as synonyms, and the variation is expressed on the cognitive level since “предметний” concerns a certain subject of the field and “прикладний” refers to the application of this subject.

The term *forward chaining* in the English language has an equivalent *прямий вивід* in the Ukrainian language. The English sentence: “*One of the advantages of forward-chaining over backward-chaining is that the reception of new data can trigger new inferences, which makes the engine better suited to dynamic situations in which conditions are likely to change*” is translated into Ukrainian as “*Однією з переваг методу прямого виводу над зворотнім є те, що прийом нових даних може призвести до отримання нових висновків. Це робить механізм виводу краще пристосованим до динамічних ситуацій, в яких умови, швидше за все, зміняться.*” As it can be observed from translation, the word “методу” (method of) was added to the term in the Ukrainian version. This clarification is quite important, considering that it is distinguished in the English language between the *method*, which is actually forward chaining, and the *process*, which is expressed by the variation *forward reasoning*. The following English sentences may serve as an example: “*Assume the following facts: 1) Fritz croaks; 2) Fritz eats flies. With forward reasoning, the inference engine can derive that Fritz is green.*” Since there is not a terminological variation in the Ukrainian language, it is desirable to add the words “method” or “process” where necessary. The terminological variation in English is caused by the cognitive contextual features at the level of expert discussion.

Similarly, the term *backward chaining* in the English language has an equivalent *зворотній вивід* in the Ukrainian language. The English sentence: “*Backward chaining starts with a list of goals (or a hypothesis) and works backwards from the consequent to the antecedent to see if any data supports any of these consequents*” is translated into Ukrainian as “*Зворотній вивід починається з переліку цілей (або гіпотез) і працює в зворотньому напрямку від висновку до антецеденту, щоб побачити, чи доступні дані, які будуть підтримувати будь-який з цих висновків.*” The Ukrainian phrase “в зворотньому напрямку” (backwards) is a good explanation for selecting this particular denomination (зворотний) for the term as it actually illustrates how the method works. *backward reasoning* is a terminological variation, exactly as in the previous case, denoting rather a process than a method itself. In the Ukrainian version, this process can be called as *зворотне міркування*, which is expressed in the following translation example: the English sentence “*It is one of the two most commonly used methods of reasoning with inference rules and logical implications – the other is forward chaining*” is translated into Ukrainian as “*Це один з двох найбільш часто використовуваних методів міркування при роботі з правилами висновування та логічними наслідками, є протилежним до прямого виводу.*” The terminological variations in English and Ukrainian are again caused by the cognitive contextual features.

The English term *automated theorem proving* has an equivalent in the Ukrainian language: *автоматичне доведення теорем*. Thus, the English sentence “*Commercial use of automated theorem proving is mostly concentrated in integrated circuit design and verification*” is translated into Ukrainian as “*В даний час автоматичне доведення теорем на виробництві застосовується в основному при розробці і верифікації інтегральних схем.*” In this example the translation is quite accurate, however, other examples may omit the last word of the Ukrainian term calling it just *автоматичне доведення*. This is not an accidental omission and is correlated with a terminological variation in the English language: *automated deduction*. Such a variation is explained by earlier inventions of this process before the wide implementation of AI, and is mostly used to

denote the process in its research history. For example, “*In the late 1960s agencies funding research in automated deduction began to emphasize the need for practical applications...This was the first automated deduction system to demonstrate an ability to solve mathematical problems...*”. So, the terminological variation is expressed at the diachronic level, and it is important for a translator to trace the history of scientific inventions in order to use the most relevant terms, considering the context of the past.

While analyzing the superordinate concept pair “*Superintelligence*” - “*Інформаційний процес*” (*Information process*), the terms *суперінтелект* (*superintelligence*), *technological singularity* and *explainable AI* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The term *суперінтелект* in the Ukrainian language was not included in the satellite concept model because it is rarely used in the scientific AI-related literature, so it has several terminological variations: *гіперінтелект* (*hyper intellect*) and *надлюдський інтелект* (*superhuman intellect*). The English sentence: “*A superintelligence is a hypothetical agent that possesses intelligence far surpassing that of the brightest and most gifted human minds*” is localized into Ukrainian as “*Суперінтелект - гіпотетичне існування особи, яка володіє інтелектом, що перевершує розумові здібності будь-якої існуючої людини.*” So, instead of the English “*agent*” in the source text, it is used “*особа*” (*personality*) in the target text. It is not easy to explain the motivation for such a substitution, but this example explains that it is quite difficult for a Ukrainian reader to imagine, for example, a machine which would possess a higher level of intelligence than any person. Due to these cognitive contextual features, several other terminological variations with reference to a human intellect are used as synonyms.

Reviewing the term *technological singularity*, the English sentence: “*The technological singularity is a hypothetical point in time at which technological growth becomes uncontrollable and irreversible, causing an “explosion” in intelligence and resulting in a powerful superintelligence that qualitatively far surpasses all human intelligence*” has been localized into Ukrainian as “*Технологічна сингулярність у футурології — гіпотетичне вибухоподібне зростання швидкості науково-технічного прогресу, яке ймовірно настане внаслідок створення штучного інтелекту і машин, здатних до самовідтворення*”. However, in some cases the term is shortened and used simply as “*singularity*” as in the following example: “*I. J. Good’s “intelligence explosion” model predicts that a future superintelligence will trigger a singularity.*” The term *singularity* is borrowed from astrophysical theories, which later turned into “*mathematical singularity*”, denoting a point at which the value of a function goes to infinity. This is why, the terminological variation is expressed at the discourse level referring to the usage of the term as an interdisciplinary one. Nevertheless, at least in Ukrainian language, it is desirable to use the full term *технологічна сингулярність* to distinguish between those used previously in history.

The English term *explainable AI* has several terminological variations, as in the following sentence: “*Explainable AI (XAI), or Interpretable AI, or Explainable Machine Learning is artificial intelligence (AI) in which the results of the solution can be understood by humans*” which can be localized into Ukrainian as “*Пояснимий штучний інтелект дозволяє розробникам і користувачам перевіряти, як він приймає свої рішення.*” As it is observed from the example, three different denominations and one abbreviation (XAI) can be used in the English language, whereas in the Ukrainian target text the only term *пояснимий штучний інтелект* appears. The variations in

English can be explained by slightly different aspects covered by each term, which can be illustrated in the following example: “*Modern complex AI techniques, such as deep learning and genetic algorithms are naturally opaque. To address this issue, there has been a development of many new methods to make new models more explainable and interpretable.*” It is obvious that a possibility to explain the model’s functioning to a person may include only general aspects, whereas interpreting of the model’s functioning comprises all the steps covered scientifically and in detail. Regarding the term ***explainable machine learning***, it is clear that not all AI-solutions are covered in general but only a specific machine learning model. So, the terminological variations are expressed here at the cognitive level when slightly different ideas are embedded in the concepts. Nevertheless, these ideas are not expressed in the Ukrainian concept system, therefore the only equivalent in translation is available.

While analyzing the superordinate concept pair “***Cognitive computing***” - “***Система обробки знань***” (*Knowledge processing system*), the terms ***speech recognition***, ***speaker recognition***, and ***mainframe computer*** have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics is explained.

Generally, the term ***speech recognition*** is translated into Ukrainian as ***розпізнавання мовлення*** like in the following examples from the “Microsoft” support page for “Windows” (Azure Architecture Center, 2022): the English sentence: “*In the search box on the taskbar, type Windows Speech Recognition, and then select Windows Speech Recognition in the list of results*” is translated into Ukrainian as: “*У поле пошуку на панелі завдань введіть Розпізнавання мовлення у Windows, а потім виберіть Розпізнавання мовлення у Windows зі списку результатів*”. However, there are multiple variations for this term in the English language, since it was borrowed from cognitive science to other fields of knowledge, which are absent in the Ukrainian language. Thus, the term ***automatic speech recognition (ASR)*** is used as a general term in the computer science, like in the sentence “*Automatic speech recognition is a high-tech that makes machine turn the speech signal to the corresponding text or command after recognizing and understanding*” (Shi, 2021, p. 539). In other fields, where the use of computers is not obvious from the context and it is necessary to specify the use of speech recognition, the term is named as “computer speech recognition”, like in the following example: “*There are, however, many other aspects of dental office practice that may be made more efficient through computer speech recognition*” (Vozick & Johnson, 2001). Also, when speech recognition is used as a part of a particular software application, then it is mostly referred to as ***speech to text (STT)***, like in the following example: “*Speech to text is a speech service feature that accurately transcribes spoken audio to text*” (Azure Architecture Center, 2022). The variations are expressed at the discourse level, considering the use of terms in different areas of knowledge and application.

The English term ***speaker recognition*** has an equivalent in the Ukrainian language ***розпізнавання мовця*** like in the example where the English sentence: “*Speaker recognition is the identification of a person from characteristics of voices*” is translated into Ukrainian as “*Розпізнавання мовця — це ідентифікація людини залежно від характеристик її голосу.*” The term can be easily confused with some of its variations, including ***speaker recognition*** in English and respectively ***перевірка мовця*** in Ukrainian, as well as ***speaker identification*** in English and respectively ***ідентифікація мовця*** in Ukrainian. The difference is that both terminological variations are some kinds of stages in the process of speaker recognition. The explanation of this difference is actually given in the following translation example where the English sentence: “*In a sense, speaker verification is a 1:1 match where one speaker’s voice is matched to a particular template whereas speaker identification*

is a 1:N match where the voice is compared against multiple templates” is localized into Ukrainian as “*На етапі перевірки, зразок мови порівнюється з раніше створеним голосовим друком. Для систем ідентифікації вимова порівнюється з декількома голосовими відбитками з метою визначення найкращої відповідності.*” So, the terminological variations in both languages are expressed at the cognitive level since the ideas expressed in the mentioned terms are slightly different.

The term *mainframe computer* in the English language has been translated into Ukrainian with the use of transcription strategy as *мейнфрейм*. Thus, the English sentence “*Mainframe computers are often used as servers*” has been localized into Ukrainian as “*Сучасні мейнфрейми перестали бути закритою платформою: вони здатні підтримувати на одній машині сотні серверів з різними ОС.*” Noticeably, the second part of the English term “computer” is not used in the Ukrainian language. This may be due to the presence of terminological variations in English, such as less official *mainframe*, as in the English sentence “*The term mainframe was derived from the large cabinet, called a main frame*” which is again localized using just the term “мейнфрейм” into Ukrainian: “*Сам термін «мейнфрейм» походить від назви типових процесорних стійок цієї системи.*” Another English variation is *big iron* which mostly appears in professional slang, as in the following example: “*Originally, the phrase ‘big iron’ probably originates from early mainframes, which were very large computers with superior capabilities enclosed in room-sized metal frames.*” (Stoltzfus, 2021). The terminological variations in English are expressed at the discourse and communicative levels since they refer to various levels of expert communication: official, less official, and non-official.

While analyzing the superordinate concept pair “*Ontology*” - “*Онтологічний інжиніринг*” (*Ontology engineering*), the terms *domain of discourse* and *ontology language* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics is explained. Furthermore, the Ukrainian term *онтологічний інжиніринг* is a borrowed from English and coined with the help of transcription strategy at the same time when a more native term *онтологічна інженерія* is used. The second version is more relevant in the context of purity of language since the lexical stem of the word “інженер” is retained in contrast with the first transcribed version of this term. However, both of them are equally used in the expert environment.

The English term *domain of discourse* has variations *a universe of discourse* and a *universe*. The definition of the *domain of discourse*: “*The domain of discourse is the set of entities over which certain variables of interest in some formal treatment may range*” slightly differs from the definition of the *universe of discourse*: “*Universe of discourse generally refers to the collection of objects being discussed in a specific discourse*” by structural components since we have the set of entities in the first case and the collection of objects in another. In a similar way, both terms slightly differ from the term *universe* defined as “*a collection that contains all the entities one wishes to consider in a given situation*” since it concerns all entities a researcher is interested in. In the Ukrainian language, this term did not go beyond mathematical science and is named as *універсальна множина* or its variation *універсум*. The example reads: “*Універсальна множина (універсум) — в теорії множин така множина U, для якої перетин цієї множини з будь-якою множиною X збігається з цією множиною X. Універсальна множина єдина*”, proving that the term is used just in the context of math, so it cannot be an adequate equivalent for the English term. In some cases, the proper terms have not yet been coined in the field of AI, which favors the emergence of multiple variations on the discourse level.

The English term *ontology language* has a Ukrainian equivalent *онтологічні мови*. In the example, the English sentence “*In computer science and artificial intelligence, ontology languages are formal languages used to construct ontologies*” is translated into Ukrainian as “*Онтологічні мови — формальні мови для побудови онтологій. Використовуються в комп’ютерних науках і штучному інтелекті.*” In a more general context, when the focus of communication is emphasized on just knowledge representation rather than on particular ontologies, the term variation *frame language* is used as in the following example: “*A frame language is a technology used for knowledge representation in artificial intelligence.*” The terminological variation in English is expressed on the cognitive level based on the dichotomy “specific and general”.

2.3.2. Analysis of terminological units and their variations in translation from English into Ukrainian based on the coordinate concepts of “Artificial Intelligence”

While analyzing the coordinate concept pair “*Reasoning*” - “*Імітація інтелектуальної поведінки*” (*Intellectual behavior simulation*), the terms *first-order logic* and *чорна скринька* (*black box*) have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The English term *first-order logic* has some terminological variations such as *predicate logic* and *quantificational logic* in the same way as its Ukrainian equivalent *логіка першого порядку*, being also called *числення предикатів* and *квантова логіка*. The terms have not been found in translation, so the use in context both for English and Ukrainian is separately analyzed below. In the English sentence: “*First-order logic allows the use of sentences that contain variables*”, and in the Ukrainian sentence: “*В логіці першого порядку допускаються висловлення відносно змінних*”, the emphasis is put on variables as the main structural components. However, in the English sentence: “*In a predicate logic a predicate is an expression of one or more variables determined on some specific domain*” and in the Ukrainian sentence: “*Числення предикатів або логіка першого порядку — це формальна система математичної логіки, в якій допускають висловлювання відносно змінних, фіксованих функцій і предикатів*” it is visible that the attention of a reader is drawn to the predicates as the main elements. In a similar way, the English sentence: “*A quantification is performed on formulas of quantificational logic (called wff), such as $x > 1$ or $P(x)$, by using quantifiers on variables*” and the Ukrainian sentence: “*Сучасні математики, на відміну від логіків, продовжують формулювати кванторні вирази переважно словами, однак вивчають теорію квантифікації з метою уникнення помилок при навішуванні кванторів*” underline the importance of quantifiers as the used items. So, a particular term variation may be used depending on the structural elements in the focus of attention during the communication process, therefore the variations are expressed at the communicative level.

The English term *black box* has two variations in the Ukrainian language: the first rather quick assumption was to name it, probably by analogy with the Russian language, as *чорний ящик*. Thus, it is observed in the following example, that the English sentence: “*The modern meaning of the term ‘black box’ seems to have entered the English language around 1945*” is translated into Ukrainian as: “*Сучасний термін ‘чорний ящик’, схоже, увійшов в науковий обіг через англійську мову в 1945 році.*” Although the term is now widely used, especially in headlines and short sentences, it is not the best choice in scientific discourse and longer sentences, since the genuine Ukrainian equivalent is *чорна скринька*. It is proved by the following example where the English sentence: “*Black-box testing is a method of software testing that examines the functionality of an application without*

peering into its internal structures or workings” is translated into Ukrainian as “Тестування методом ‘чорної скриньки’ - це метод тестування програмного забезпечення, при якому перевіряється робота програми без знання її внутрішньої побудови та схеми роботи.” The variation is rather expressed on the diachronic level, since in the beginning there was an urgent need to provide an equivalent term in the Ukrainian version which was not accurate but which later was changed into the relevant one.

While analyzing the coordinate concept pair “*Decision making*” - “*Прийняття рішень*”, the terms *a Bayes estimator* and *rational agent* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The English term *a Bayes estimator* has a terminological variation *a Bayes action* that corresponds to the Ukrainian term *Бассова оцінка* and its variation *Бассова дія*. Generally, both terms are used as synonyms like in the English sentence: “*In estimation theory and decision theory, a Bayes estimator or a Bayes action is an estimator or decision rule that minimizes the posterior expected value of a loss function*” which is translated into Ukrainian as “*У теорії оцінювання та теорії рішень баєсова оцінка або баєсова дія є оцінкою або правилом ухвалення рішення, що мінімізує апостеріорне математичне сподівання функції втрат*”. However, not many sources indicate to the frequency of using the terminological variation *Бассова дія*, instead the first option prevails in texts. As for the English language, the terminological variation *a Bayes action*, compared to *a Bayes estimator* supposing the process, mostly illustrates the result of it as in the following example: “*There may exist some conditions in which the Bayes action cannot be easily obtained.*” So, the terminological variations are expressed at the cognitive level, implying slightly different ideas in the concepts.

The English term *rational agent* corresponds to the Ukrainian *раціональний агент*. The English sentence: “*Rational agents in AI are closely related to intelligent agents, autonomous software programs that display intelligence*” has been localized into the Ukrainian language as: “*В даний час, у галузі ШІ, поняття ‘раціональний агент’ тісно пов’язане з поняттям ‘інтелектуальний агент’.*” There is a terminological variation in English: *rational being* caused by the fact of borrowing this term into the field of AI from other disciplines, including cognitive theory, economics, ethics etc. Analyzing the following example: “*A rational being is someone who is sensible and is able to make decisions based on intelligent thinking rather than on emotion*”, it is possible to state that this terminological variation may be used in other sciences beyond AI, and, thus, is expressed at the discourse level.

While analyzing the coordinate concept pair “*Algorithm*” - “*Метод*” (*Method*), the terms *random forest* and *decision tree learning* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The term *random forests* in the English language is translated into Ukrainian as *випадкові ліси* or is being directly infiltrated saving the graphical form *random forests*. The English sentence “*Random forests can be used to rank the importance of variables in a regression or classification problem in a natural way*” is translated into Ukrainian as “*Випадкові ліси, отримані в результаті застосування технік, описаних раніше, можуть бути природним чином використані для оцінки важливості змінних в задачах регресії та класифікації.*” So, *випадкові ліси* is used in the target text in the situation which concerns the description of this algorithm. However, in the following example

“Розширення алгоритму було запропоновано Лео Брейманом і Аделем Катлером, ‘*Random Forests*’ є їхньою торговою маркою”, the term **random forests** is described as a trademark and, thus, conveyed just as it was in English. Another terminological variation in the English language is **random decision forests**. When it is necessary to focus on the connection of this method with the approach of “decision trees” (is further analyzed), the terminological variation of “random decision forests” is used, as in the following example: “*Random decision forests correct for decision trees’ habit of overfitting to their training set.*” So, the terminological variations are expressed here at the communicative level, since it really depends on the situation of expert dialogue which denomination is more relevant.

The English term **decision tree learning** has a Ukrainian equivalent **дерева рішень у машинному навчанні** which is used in plural instead of singular because this is relevant regarding the concept of this method described as a metaphor to branches and leaves in the same way as the English terminological variation **induction of decision trees** is represented. The English sentence: “*Decision tree learning uses a decision tree (as a predictive model) to go from observations about an item (represented in the branches) to conclusions about the item’s target value*” is translated into Ukrainian as: “*Дерева рішень у машинному навчанні використовуються як передбачувані моделі, що відображають знання про об’єкт (представлені гілками) у множині рішень.*” As it can be observed, the principle of approach is described in the mentioned example. However, when the action of this process is meant, **induction of decision trees** is a more relevant option in English, as illustrated by the example: “*This process of top-down induction of decision trees is an example of a greedy algorithm.*” The terminological variation is expressed at the cognitive level, since the terms may be used as synonyms but convey slightly different ideas based on their concept characteristics.

While analyzing the coordinate concept pair “**Machine learning**” - “**Машинне навчання**”, the terms **навчання з учителем** (*supervised learning*), **навчання без учителя** (*unsupervised learning*), **напівавтоматичне навчання** (*semi-supervised learning*) and **learning to rank** have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The Ukrainian term **навчання з учителем** in the context of AI corresponds to the English term **supervised learning** and has some terminological variations: **контрольоване навчання** and **кероване навчання**. The English sentence: “*Supervised learning (SL) is the machine learning task of learning a function that maps an input to an output based on example input-output pairs*” is localized into Ukrainian as “*Комп’ютеріві представляють приклади входів та їхніх бажаних виходів, задані ‘вчителем’, і метою є навчання загального правила, яке відображає входи на виходи.*” Literally, “learning with a teacher” became a term generally covering the concept of “supervised learning”, where the teacher is human interference providing a machine with the examples of how to analyze data. However, when it goes about the algorithms of such learning, an adjective should be used instead of “learning with a teacher”, this is where the terminological variations “контрольоване навчання” and “кероване навчання” are applied. For example, the Ukrainian sentence: “*Набір вхідних даних (X) та набір відповідних значень відгуку або результатів (Y) надаються керованому алгоритму навчання*” would be translated into English as “*A set of input data (X) and a set of corresponding response values or results (Y) are provided to the supervised learning algorithm*”. Thus, terminological variations here are expressed at the communicative level, since it depends on the communicative situation among experts when this or another term variant should be used.

The Ukrainian term *навчання без учителя* in the context of AI corresponds to the English term *unsupervised learning* and has a terminological variation: *спонтанне навчання*. The English sentence: “*Unsupervised methods exhibit self-organization that captures patterns as probability densities or a combination of neural feature preferences*” is localized into Ukrainian as “*Навчання без учителя може бути метою саме по собі (виявлення прихованих закономірностей у даних), або засобом досягнення мети (навчання ознак).*” Literally, “learning without a teacher” became a term generally covering the concept of “unsupervised learning”, where the process is done without human interference providing a machine with the examples of how to analyze data. However, as in the previous case, a tricky linguistic example when the adverb needs to be created from the noun phrase, the option “навчання без учителя” would not be relevant in Ukrainian language. The following sentence is an example when *спонтанне навчання* may better explain the process: “*Один зі способів машинного навчання, при вирішенні яких випробовувана система спонтанно навчається виконувати поставлене завдання, без втручання з боку експериментатора*” which can be translated into English as: “*One method of machine learning in which a test system spontaneously (in an unsupervised way) learns how to perform a given task, without intervention from the experimenter*”. The logic is that if the system spontaneously learns, then it is called “*spontaneous (unsupervised) learning*” in Ukrainian language. Thus, terminological variation is also expressed at the communicative level, since it depends on the communicative situation among experts when this or another term variant should be used.

The Ukrainian term *напівавтоматичне навчання* in the context of AI corresponds to the English term *semi-supervised learning* and has a terminological variation: *навчання з частковим залученням учителя*. The English sentence: “*A freely available MATLAB implementation of the graph-based semi-supervised algorithms Laplacian support vector machines and Laplacian regularized least squares*” is translated into Ukrainian as: “*Вільно доступна реалізація MATLAB графа на основі алгоритмів напівавтоматичного навчання лапласівського методу опорних векторів та лапласівської регуляризації методом найменших квадратів.*” Like in the previous cases, but with terminological variations, for describing an object the Ukrainian language requires using an adjective which has been used in the given example. However, when there is a need to explain the approach to machine learning as such that partly involves an expert, the term *навчання з частковим залученням учителя* is used, as in the following example: “*Навчання з частковим залученням вчителя – це підхід до машинного навчання, який поєднує невелику кількість маркованих даних з великою кількістю немаркованих даних під час навчання.*” As previously, a terminological variation is expressed at the communicative level, since it depends on the communicative situation among experts when this or another term variant should be used.

The English term *learning to rank* has a terminological variation *machine-learned ranking (MLR)* and corresponds to the Ukrainian equivalent *навчання ранжуванню* with the terminological variation *машинне-навчання ранжуванню (МНР)*. The English sentence: “*Learning to rank algorithms have been applied in areas other than information retrieval*” is translated into Ukrainian as: “*Алгоритми навчання ранжуванню були застосовані в інших областях, окрім пошуку інформації*”. Apparently, the term used in both cases generally describes relevant algorithms, and for the one skilled-in-the-art it is obvious which type of approach is applied. However, in the situations when it is necessary to describe specific elements of the system related to this type of machine learning, the terminological variation *machine-learned ranking* is used in both languages. Thus, the English sentence: “*Query-dependent or dynamic features — those features, which depend*

both on the contents of the document and the query, such as TF-IDF score or other non-machine-learned ranking functions” is translated into Ukrainian as: “Залежні від запиту або динамічні ознаки — ті ознаки, які залежать як від вмісту документа, так і від запиту, наприклад, результату TF-IDF або інших функцій ранжування, які не є алгоритмами МНР.” Terminological variations are expressed here at the communicative level, considering different types of messages describing either the approach as a whole, or its specific elements.

While analyzing the coordinate concept pair “*Analytics*” - “*Інтелектуальна процедура*” (*Intelligent procedure*), the terms *cluster analysis* and *масово-паралельна архітектура* (*Massively parallel*) have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The English term *cluster analysis* corresponds to the Ukrainian *кластерний аналіз* when it concerns the specific action of grouping objects into similar groups. The English sentence: “*Cluster analysis itself is not one specific algorithm, but the general task to be solved*” is translated into Ukrainian as “*Кластерний аналіз — це не якийсь один алгоритм, а загальна задача, для розв’язання якої використовуються різні підходи.*” However, when it is intended to emphasize the process of this action, the terminological variations *clustering* in English and *кластеризація* in Ukrainian are applied. For example, the English sentence: “*Hierarchical clustering builds models based on distance connectivity*” is translated into Ukrainian as: “*Ієрархічна кластеризація або таксономія будуються на основі відстані між вузлами.*” Terminological variations in both languages are expressed at the cognitive level, since the terms are mostly synonymic but contain slightly different ideas, namely, the action and the process of this action.

The Ukrainian term *масово-паралельна архітектура* has an equivalent in the English language: *massively parallel* and some terminological variations: *масивно-паралельна система* and *масивно-паралельний процесор*. The English sentence “*Massively parallel is the term for using a large number of computer processors (or separate computers) to simultaneously perform a set of coordinated computations in parallel*” is approximately localized into Ukrainian as: “*Масово-паралельна архітектура - це архітектура паралельної ЕОМ з розподіленими блоками обчислень, зокрема розподіленою пам’яттю, тобто з наявною в кожного з процесорів власної пам’яті.*” In this example, by the architecture a set of computer processors is meant. However, in another Ukrainian example, the main purpose of the message is drawing the attention to interaction between processors within the system, so the term *масивно-паралельні системи* is used: “*Оскільки масивно-паралельні системи - це комп’ютер з розподіленою пам’яттю, то взаємодія процесорів, в основному, здійснюється за допомогою передачі повідомлень один одному.*” In yet another example, although this concerns the same set of processors, it is emphasized that all of them are united into one computer, so *масивно-паралельний процесор* is more relevant in the following case: “*Масивно паралельний процесор - це один комп’ютер з багатьма процесорами з’єднаними в мережу.*” Terminological variations in the Ukrainian language are expressed at the cognitive level, since the English version retains one basic term, and it is typical in Ukrainian context to differentiate the whole from its components, and the specifics of how these components work.

2.3.3. Analysis of terminological units and their variations in translation from English into Ukrainian based on the subordinate concepts of “Artificial Intelligence”

While analyzing the subordinate concept pair “*Narrow intelligence*” - “*Машинний ‘інтелект’*”, the terms *artificial neural networks* and *EOM (computer)* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained. At the same time, the term *narrow intelligence* has a terminological variation *weak intelligence*, as in the following examples: “*All systems that currently exist have narrow AI, e.g. Alexa voice assistant from Amazon, does not have intelligence although we may have the illusion that it does*” and “*It is notable that weak AI has possessed the ability to surpass human such chess playing.*” The Ukrainian language has several equivalents which may also be considered as terminological variations, such as *вужький ШІ* or *слабкий ШІ*, although these are loan words from the English terms and are not coined exactly according to the lexical rules of the Ukrainian language. A better option is *обмежений ШІ* since this term clearly explains the limits of technological solution, as in the example: “*Обмежений штучний інтелект чудово справляється з якимось одним конкретним завданням.*” However, the most relevant designation in Ukrainian is *штучний інтелект вужького спектру* which makes it clear that the specter of its functionality is limited, as in the example: “*Штучний інтелект вужького спектру – перший рівень штучної свідомості, яка спеціалізується на прийнятті рішень лише в одній сфері: наприклад, може обіграти світового чемпіона з шахів, але може зробити тільки це і нічого більше.*” (Maksymchuk, 2017)

The English term *artificial neural networks* is sometimes referred as just *neural networks* in the field of AI and corresponds to the Ukrainian equivalent *штучні нейронні мережі*, rarely also called as *конективістські системи*. The English sentence: “*Artificial neural networks are based on a collection of connected units or nodes called artificial neurons, which loosely model the neurons in a biological brain*” is translated into Ukrainian as: “*Штучні нейронні мережі ґрунтуються на сукупності з’єднаних вузлів, що називають штучними нейронами (аналогічно до біологічних нейронів у головному мозку тварин).*” In this case, the full term is used in both cases as it concerns the definition of the system. However, in the English-speaking expert environment it is accepted sometimes to miss the first part of the term “artificial” since it is clear from the context that not biological neural networks are in focus, as in the following example: “*‘Neural networks’ early successes included predicting the stock market and in 1995 a (mostly) self-driving car.*” Another terminological variation *конективістські системи* can substitute the commonly established term in the Ukrainian language, since the invention of artificial neural networks is linked to applying of these systems. The following example in the Ukrainian language describes its potential usage: “*Румельхарт та МакКлелланд (1986) описали застосування конективізму для моделювання нейронних процесів*”. So, both English and Ukrainian terminological variations are expressed at the discourse level, since they appear depending on the field of knowledge or the level of expert knowledge.

The Ukrainian term *EOM* or *електронна обчислювальна машина* can still appear in the scientific literature and refers to the English equivalent “computer”. However, “EOM” is a general term for digital electronic machines beginning from the first electric and mechanical devices and ending with the modern. This term can be used to differentiate the early computers from the modern ones in Ukrainian literature, as in the following example: “*Термін ‘EOM’ використовується щоби показати відмінність від історичного попередника комп’ютера — механічної обчислювальної машини.*” However, in general cases the loan word from the English language *комп’ютер*

corresponds to the English **computer** as in the following sentence: “A computer is a digital electronic machine that can be programmed to carry out sequences of arithmetic or logical operations (computation) automatically” which is localized into Ukrainian as “Комп’ютер у вузькому значенні — це електронний пристрій з можливістю програмування (раніше також називався ‘електронна обчислювальна машина’), який здійснює обчислення за заздалегідь визначеним алгоритмом.” So, the terminological variation is expressed here at the diachronic level, since it is possible to trace the term etymology and the reason for this change due to historic reasons in this example.

While analyzing the subordinate concept pair “**Strong intelligence**” - “**Модельовання свідомості**”, the terms **artificial consciousness** and **mind uploading** have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained. At the same time, the term **strong intelligence** is mainly used to emphasize a computer’s system capability of consciousness that can be concluded from analyzing the English sentence: “*In contrast to strong AI, weak AI or ‘narrow AI’ is not intended to have general cognitive abilities*” translated into Ukrainian as: “Слабкий штучний інтелект, на відміну від сильного, не намагається виконати повний спектр людських когнітивних здібностей.” However, it has a terminological variation **general artificial intelligence** or just **general intelligence**, referring to the capability of a machine to perform on a human level without a separate focus on consciousness as the main factor, as in the following example: “*The first generation of AI researchers were convinced that artificial general intelligence was possible and that it would exist in just a few decades.*” Terminological variation is expressed at the cognitive level here, implying a more specific and a more general understanding of the same term.

The English term **artificial consciousness** has an equivalent in the Ukrainian language: **штучна свідомість**, used mostly in the context of describing this phenomenon in general, as in the following examples where the English sentence: “*Artificial consciousness concepts are also pondered in the philosophy of artificial intelligence through questions about mind, consciousness, and mental states*” is localized into Ukrainian as: “Штучну свідомість можна розглядати як розширення штучного інтелекту, припускаючи, що поняття інтелекту, в його зазвичай використовуваному сенсі, дуже вузьке для того, щоб включати всі аспекти свідомості.” However, the terminological variation **machine consciousness** which has the same equivalent in the Ukrainian language: **машинна свідомість** is used in the context when the exact capability of the system is emphasized, like in the example where the English sentence: “*In 2014, Victor Argonov suggested a non-Turing test for machine consciousness based on machine’s ability to produce philosophical judgments*” is translated into Ukrainian as “У 2014 році Віктор Аргонов запропонував тест Тьюрінга для свідомості машини на основі здатності машини виробляти філософські судження.” Consequently, the terminological variation is expressed at the cognitive level since the understandings of the term as a process and as a capability are introduced here.

The term **mind uploading** in the English language corresponds to the Ukrainian term **завантаження свідомості** when it is reviewed in the context of a hypothetical phenomenon. For example, the English sentence: “*Mind uploading is the theoretical futuristic process of scanning a physical structure of the brain accurately enough to create an emulation of the mental state (including long-term memory and ‘self’) and transferring or copying it to a computer in a digital form*” is translated into Ukrainian as “Завантаження свідомості - це гіпотетична технологія сканування і мапування головного мозку людини, що дозволить перенести свідомість і підсвідомість людини в іншу систему, на якийсь інший носій, можливо, цифровий (наприклад, комп’ютер зі

штучною нейронною мережею).” However, the terminological variation **whole-brain emulation** is used in English when the attention is drawn to the process or to the action itself which is slightly different from the description of phenomenon in general. Such use of the terminological variation is illustrated in the following example: “*Whole-brain emulation is discussed by some futurists as a ‘logical endpoint’ of the topical computational neuroscience and neuroinformatics fields, both about brain simulation for medical research purposes.*” Thus, the terminological variation is expressed at the cognitive level since the understanding of the term as the phenomenon and as the process or action is distinguished.

While analyzing the subordinate concept pair “**Natural language processing**” - “**Обробка природної мови**”, the terms **lexical analysis** and **natural language understanding** have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The English term **lexical analysis** in the field of AI has the Ukrainian equivalent: **лексичний розбір**, which refers to the concept of transformation and processing of lexical symbols by a machine. In the example, the English sentence “*Lexical analysis is the process of converting a sequence of characters into a sequence of tokens (strings with an assigned and thus identified meaning)*” is translated into Ukrainian as: “*Лексичний розбір це процес перетворення послідовності символів в послідовність токенів (груп символів що відповідають певним шаблонам), та визначення їх тунів.*” However, the terminological variation **tokenization** which has the same equivalent in the Ukrainian language: **токенізація** is used in the context when it concerns categorizing of already processed language symbols by the machine, that may be observed from the example in translation, where the English sentence: “*Tokenization is the process of demarcating and possibly classifying sections of a string of input characters*” is translated into Ukrainian as: “*Токенізація — це процес розмежування та, можливо, класифікації секцій рядка вхідних символів.*” So, the terminology variations in both languages are expressed at the communicative level when the expert discussion may touch various aspects of one and the same process, namely, the different steps of it.

The term **natural language understanding** in the English language corresponds to the Ukrainian term **розуміння природної мови** used to define the general process of processing natural language in the AI. The English sentence: “*Advanced applications of natural-language understanding also attempt to incorporate logical inference within their framework*” is translated into Ukrainian as: “*Розвинені програми розуміння природної мови також намагаються включити у свої рамки й логічне висновування*”. However, exactly as in several previous cases, when a particular action within this process is meant, the terminological variation **natural language interpretation** is used, as in the following English example: “*Thus the goal of unambiguous natural language interpretation, in the absence of contextual cues, may not be appropriate or achievable*”. The example in the Ukrainian language: “*Команда експертів працює над технологіями інтерпретування природної мови (підрозділ, що вивчає, як ШІ розуміє прочитане)*” shows that a terminological variation **інтерпретування природної мови** (natural language interpretation) is used synonymously, being rather as a loan term from the English terminological variation without importing the difference of its understanding. So, the English terminological variation is expressed at the cognitive level since its understanding as an action is different from the understanding of the process in general as it is represented by the first term.

While analyzing the subordinate concept pair “*Intelligent agent*” - “*Багатоагентна система*” (*Multi-agent system*), the corresponding terms: *intelligent agent* and *a multi-agent system* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

In AI, the concept “*Intelligent agent*” can be expressed via several terminological variations. The English term *intelligent agent* corresponds to the Ukrainian equivalent *інтелектуальний агент* in the context relevant to a general description of goal-related action, which is the function of an intelligent agent. In this case, the English sentence: “*Intelligent agents are not just computer programs: they may also be machines, human beings, communities of human beings (such as firms) or anything that is capable of goal-directed behavior*” is translated into Ukrainian as: “*Інтелектуальний агент не завжди є програмним продуктом. Він може бути також машиною, людською істотою, спільнотою людських сутностей (як, наприклад, бізнес-спільнота) або чим-небудь ще, здатним до цілеспрямованої поведінки.*” However, there can be a different context when the concept is denoting a particular type of action which is not only goal-related but quite balanced and resultful depending on the initial data. In this case, the terminological variation *rational agent* in English and *раціональний агент* in Ukrainian is more relevant, as in the following English sentence: “*A rational agent is a person or entity that always aims to perform optimal actions based on given premises and information*” which is translated into Ukrainian as: “*Раціональний агент - це агент, що діє оптимальним для досягнення найкращого очікуваного результату чином.*” Also, the terminological variation can be a *software agent* in English and respectively *програмний агент* in Ukrainian. So, the English sentence: “*A software agent is a computer program that acts for a user or other program in a relationship of agency*” would be translated into Ukrainian as: “*У комп'ютерних науках програмний агент — це програма, яка вступає у відношення посередництва з користувачем або іншою програмою.*” In this context, the concept is clearly defined as a software program which is also goal-oriented and uses the given resources for achieving the best result but the focus is emphasized on helping a user, when referring to this term. So, the terminological variations are expressed at the communicative level, since they are parts of messages delivering different information loads in a particular environment.

The English term *multi-agent system* has a Ukrainian equivalent *багатоагентна система*, meaning and referring to the concept of the system consisting of the elements called intelligent agents. The English sentence: “*A multi-agent system is a computerized system composed of multiple interacting intelligent agents*” is translated into Ukrainian as: “*Багатоагентна система — це система, утворена декількома взаємодіючими інтелектуальними агентами.*” However, in a context when the emphasis is placed on the specifics of structural components’ interaction rather than just on naming these components, the terminological variation *self-organized system* is used in English, as in the following example: “*In a self-organized system, the parts influence each other.*” In the Ukrainian language, a loan term from English named as *мультиагентна система* is used as a terminological variation in the scientific work which is most likely intended to show the speaker’s affiliation to the expert community, as in the following example: “*Для вирішення складних проблем досить часто використовують мультиагентні системи, що складаються з набору агентів, які виконують окремі функції та взаємодіють в процесі цього з іншими агентами.*” Thus, the English terminological variation is expressed at the cognitive level, carrying a slightly different idea with a focus on interaction between the structural elements, and the Ukrainian terminological

variation is expressed at the discourse level by means of using a foreign term, making the message sound more related to a specialized field.

While analyzing the subordinate concept pair “*Long short-term memory*” - “*Нейронна мережа*” (*Artificial neural network*), the corresponding terms: *convolutional neural network* and *комп’ютерний зір* have been selected, reviewed on the matter of terminological variation emergence, and the translation specifics are explained.

The English term *convolutional networks* corresponds to the Ukrainian equivalent *згорткові мережі* referring to the deep learning technique to analyze images. The English sentence: “*Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the animal visual cortex*” is translated into Ukrainian as: “*Згорткові мережі взяли за основу біологічний процес, а саме схему з’єднання нейронів зорової кори тварин.*” However, this term was previously introduced for recognition of images as a *shift neural network* in English which is *інваріантна відносно зсуву нейронна мережа* in Ukrainian. The following English sentence: “*Similarly, a shift invariant neural network was proposed by W. Zhang et al. for image character recognition in 1988*” is translated into Ukrainian as: “*Аналогічно, інваріантну відносно зсуву нейронну мережу було запропоновано для розпізнавання зображень символів 1988 року.*” This concept was used earlier and was changed later into the convolution-based technology. Thus, the terminological variation is expressed at the diachronic level, since the term which had been used before was changed by a more modern one.

The term *комп’ютерний зір* in the Ukrainian language has an equivalent *computer vision* in English and has a terminological variation *комп’ютерне бачення*. The English sentence: “*The scientific discipline of computer vision is concerned with the theory behind artificial systems that extract information from images*” has been localized into Ukrainian as: “*Як технологічна дисципліна комп’ютерний зір прагне застосувати теорії та моделі комп’ютерного зору до створення систем комп’ютерного зору.*” In this example, the terms for “vision” in both languages are used as a phenomenon or a capability used by a system to make and process images. However, in the following example, the English sentence: “*Fully autonomous vehicles typically use computer vision for navigation, e.g. for knowing where it is, or for producing a map of its environment and for detecting obstacles*” is translated into Ukrainian as: “*Повністю автономні транспортні засоби використовують комп’ютерне бачення для навігації, тобто для отримання інформації про місце свого положення, для створення мапи навколишнього оточення, для визначення перешкод.*” The terminological variation *комп’ютерне бачення* appears when the vision is performed as a process or a set task by a system. So, terminology variation in the Ukrainian language is expressed here both at the cognitive and communicative levels, since there is a difference in understanding of the capability and performance, which is introduced in the particular communicative situation.

So, the analysis of terminological variations in translations from English into Ukrainian illustrated that those may appear due to the impact of contextual features such as: cognitive, communicative, discourse, and diachronic. Identifying the mentioned contextual features helps a translator identify the reasons for term variation and make a decision if the use of such variation is relevant in the target text. It can be the case when terminological variations may be used in both languages simultaneously, or only in English, or only in Ukrainian. This is motivated by different concept systems in two languages, and these differences can be traced from the analysis of a satellite concept model. The

analyzed translation examples prove that the terminological units of the target texts may be loan translations, borrowings, neologisms, descriptive translations and even archaisms. It shows that multiple translation strategies are being used in the formation of terminological units as well as variations, and knowing these strategies may make it easier for the translator to find the appropriate term. As it is outlined, terminological variations may emerge due to a different understanding of some concepts as a whole or their aspects in a particular language; the level of expertise which is characterized by addressing to different terminology; the audience, purpose of the message and communicative situation; time when the text was created (diachronic approach); a scientific school if it concerns the translation of scientific works, etc.

Conclusions

1. Systematic literature analysis of translation-oriented terminology-related publications has been done in order to identify the aspects of work with terminological units and their variations for translators. It is important for any translator to know that a terminological unit is different from any other lexical unit by the fact of its belonging to a specialized domain and its use by experts in a particular field of science or professional activity. Terminology work is an initial part of any translation project, but before taking it up, beginners especially need to familiarize themselves with the standards of terminology formation and requirements for filling in the entries in a database. It has been defined that the concept system plays the central role in terminology work, and any analysis of terms starts with identifying the main concepts, their types, and relationships among them. A concept system, be it a hierarchy or a satellite model, serves as a map for the further selection of terminological units from a particular field to analyze their composition, semantic structure, and possible contexts. A properly chosen concept may be used to extract the terms equivalent in multiple languages, but it is always necessary to verify the context of usage in each case.
2. The motivations for terminological variation as well as the contextual features causing this process have been defined. Terminological variations may refer to one and the same concept, however, be used in different contexts. Also, it should be considered that even one and the same designation may have different semantic values in various cases of usage. These alternative denominations may be motivated by such contextual features as cognitive, when there are various aspects of concept understanding; communicative, when the purpose of the message and the target audience may affect the concept; discourse, when a concept is reviewed in a certain environment such as a particular field of science, and diachronic, when the perception of a concept changed over time. Currently, translation-oriented terminology, as an integral part of all translation projects, includes the search, collection of terms, their documentation, and updating the database. The last step is especially relevant, considering a fast tempo of development of certain fields like artificial intelligence where new terminological variations may appear.
3. The artificial intelligence-related concepts and relationships among them in the English and Ukrainian languages have been analyzed. While making up a concept model, a translator may identify: 1) similar concepts used in different fields of science and expressed by the same denominations; 2) different denominations in two languages within one field of science referring to one and the same or two very similar concepts; 3) slightly different concepts expressed by the same denominations in various fields of science; 4) slightly different concepts expressed by very different denominations within one field of science. This analysis may help a translator avoid confusing concepts and terms used in a particular thematic field, for example, “artificial intelligence” and “computer intelligence”, which may result in creating wrong translations. Also, investing one’s time in building a satellite concept model is a good method to determine the concepts which may be attributed by mistake to a general thematic field when in reality they may refer to a specific field, having different meanings in this discourse, for example: “decision making”, “ontology”, “subject domain”, “intelligent procedure”, etc.
4. The relevance of using terminological variations from the field of artificial intelligence in a particular context on the example of translation from English into Ukrainian have been explained. Since concepts influence the term formation, different aspects of understanding a particular object, phenomenon or event may be embedded in specialized terms. Such aspects may sometimes be imported, for example from English into Ukrainian, or appear anew in one language due to the

peculiarities of cultural understanding of things interacting in the world. There are rare cases when an old term is displaced by a newer one in one language but this is not happening in another language because the field has not reached the same development level. All these nuances should be taken into consideration while translating the specialized terms in the field of artificial intelligence from English into Ukrainian and keep in mind that a reader has the right to understand the meaning which was initially included in a particular term. In this sense, the English and the Ukrainian languages do not stand on equal positions, since the concepts of artificial intelligence were developed in the English-speaking countries and have to be imported into Ukrainian together with the English “picture of the world”, including the loan words and barbarisms. However, as it was noticed, in the cases when a particular term has a tradition of usage in Ukrainian science, the aspects of its understanding do not disappear when the term is used in AI, and when the English equivalent can just be a single one, the Ukrainian term may include one or several variations.

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