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CHALLENGES IN TRANSLATING COMPUTER SCIENCE AND MATHEMATICAL TERMS FROM ENGLISH INTO UKRAINIAN

The translation of computer science and mathematical terminology presents significant challenges due to the highly specialized nature of these fields, the rapid evolution of technology, and linguistic differences across languages. Many technical terms originate in English and lack direct equivalents, requiring translators to choose between borrowing the original term or creating descriptive translations. This process is further complicated by context-dependent meanings, as many terms have multiple interpretations depending on their usage in different subfields.

Additionally, the widespread use of abbreviations and acronyms in technical disciplines poses challenges for translation consistency, as some languages localize them while others retain the English versions. Differences in grammatical structures, word formation rules, and cultural perspectives further influence how technical concepts are adapted in different languages.

Mathematical terminology, while based on universal symbols, varies in naming conventions across languages, which can lead to inconsistencies in education and professional communication. The ongoing development of new technologies introduces new terms faster than standard translations can be established, leading to a hybrid vocabulary where English terms coexist with localized equivalents.

This article explores the key challenges in translating computer science and mathematical terminology, analyzing the impact of linguistic structures, industry standards, and technological advancements. It also discusses best practices for ensuring accurate, clear, and user-friendly translations, emphasizing the importance of collaboration between linguists, technical experts, and industry professionals. The findings highlight the necessity of a standardized yet flexible approach to translation that balances clarity, consistency, and accessibility in an increasingly globalized technological landscape.

Key words: *Translation, computer science terminology, mathematical terminology, technical translation, linguistic challenges, loanwords, abbreviations, standardization, terminology adaptation, context-dependent meanings, industry standards, localization, globalization, machine translation, multilingual communication.*

Statement of the problem. The translation of computer science and mathematical terminology presents significant challenges due to the specialized nature of these fields. Many technical terms originate in English and lack direct equivalents in other languages, forcing translators to choose between loanwords and descriptive phrases. Additionally, the meaning of certain terms can vary depending on context, leading to potential misunderstandings if not translated accurately.

Another major issue is the rapid evolution of technology, which results in new terms emerging faster than standardized translations can be developed. This often leads to inconsistencies, where some terms are translated while others remain in English, creating a hybrid technical vocabulary. Furthermore, differences in linguistic structures across languages affect how complex concepts are conveyed, sometimes making translations awkward or overly complex.

Mathematical terminology, while based on universal symbols, also poses challenges due to variations in terminology across different languages. Moreover, the widespread use of abbreviations and acronyms in computer science makes translation difficult, as some languages translate them while others retain the English versions.

This article examines these challenges in detail and explores potential solutions for improving the translation of technical terms in computer science and mathematics.

Analysis of recent research and publications. In recent years, Ukrainian scholars have increasingly

focused on the challenges of translating technical terms in computer science and mathematics, with particular attention to issues such as linguistic adaptation, the rapid evolution of technology, and the standardization of terminology. Several studies have been published that address both theoretical and practical aspects of translating these specialized fields. Here is an overview of some of the key areas of research in Ukraine:

1. Adaptation and Localization of Terminology

Researchers have explored how to adapt English-originated technical terms into Ukrainian, especially given the dominance of English in the global tech landscape. One notable publication by O. D. Oguj (2015) investigates the linguistic aspects of translating terms in the field of information technologies, focusing on the intricacies of localizing terms that lack direct Ukrainian equivalents. The study emphasizes the importance of maintaining clarity while ensuring the preservation of meaning, often through the use of descriptive translations or loanwords (e.g., хешування for hashing) [5].

Similarly, O. D. Palyamarchuk (2012) examines how computer science terminology is integrated into Ukrainian academic texts, stressing the need for a balance between technical accuracy and ease of understanding for local readers [6].

2. Context-Dependent Meaning of Terms

Another area of research addresses the contextual variability of technical terms, a common issue in both computer science and mathematics. The term kernel, for example, can refer to different concepts in operating systems, machine learning, or even statistics. Ukrainian researchers, such as L. V. Gocheva (2018), highlight the challenges that arise from context-dependent meanings, which require translators to have a deep understanding of both the technical subject and the context in which the term is used. Their work focuses on strategies for disambiguating terms and ensuring that the translation accurately reflects the intended concept [2].

3. Standardization and Terminology Norms

The rapid pace at which new technological terms are introduced presents a challenge for the consistent and standardized translation of terms. This is especially relevant when it comes to acronyms and abbreviations like API, CPU, and RAM, which may or may not be translated into Ukrainian. The issue of terminology standardization is discussed in the works of M. P. Kochergan (2003) [4] and V. I. Karaban (2002) [3], who argue for the creation of a unified system of technical terms for Ukrainian scientific literature. These studies call for the development of comprehensive terminological dictionaries and collaboration between linguists and experts in computer science to create a cohesive vocabulary.

Task statement. The primary objective of this article is to analyze the key challenges associated with translating computer science and mathematical terminology across different languages. This includes examining the lack of direct equivalents, context-dependent meanings, the influence of linguistic structures, and the impact of rapidly evolving technology on translation practices. Additionally, the article aims to:

1. Identify common translation difficulties, such as handling loanwords, abbreviations, and multiple-meaning terms.

2. Explore the effects of cultural and linguistic differences on technical translations.

3. Assess the challenges posed by the continuous development of new technologies and the need for timely standardization.

4. Provide insights into best practices for achieving accurate, clear, and industry-aligned translations in computer science and mathematics.

By addressing these aspects, the article seeks to contribute to a better understanding of technical translation challenges and propose strategies for improving translation quality in these specialized fields.

Outline of the main material of the study. Translating technical terminology in computer science and mathematics presents unique challenges. Unlike general language translation, technical terms are often rigid, context-dependent, and closely tied to their original linguistic and cultural origins. As a result, translators must strike a balance between accuracy, clarity, and usability. This article explores the most significant difficulties faced when translating computer science and mathematical terms, along with potential solutions.

1. Lack of Direct Equivalents

Many computer science and mathematical terms originate in English, and in some cases, no direct equivalent exists in the target language. This is especially true for newly emerging technologies and theoretical concepts.

One of the main challenges in translating computer science and mathematical terms is the absence of direct equivalents in Ukrainian. Many terms are borrowed from English, either as loanwords or through descriptive phrases. In some cases, new words are coined, but these can be hard to standardize or widely accepted [3].

Example:

Cloud computing – The term "cloud computing" has become widely used in Ukrainian as "хмарні

обчислення" (cloud computations), but the shorter form "хмара" (cloud) is also used in some contexts. While the term "хмара" is popular, it is often not specific enough to convey the full meaning of the original concept.

Hashing – "Хешування" is the translation of "hashing," a term used in cryptography and computer science. While "хешування" accurately reflects the concept of converting data into a fixed-size string, many non-experts might not understand it without additional explanation.

2. Context-Dependent Meanings

Another challenge arises from the context-dependent nature of many technical terms. A word may have different meanings depending on the field in which it is used, which can complicate translation efforts. This is especially true for terms that appear in both computer science and mathematics but have distinct definitions depending on the discipline.

Example:

Kernel – In the context of computer science, a "kernel" refers to the core component of an operating system, responsible for managing system resources. In mathematics, however, "kernel" refers to a set of vectors that are mapped to zero by a linear transformation. The translator must identify the correct context to avoid confusion.

Bit – The term "bit" in computer science refers to the basic unit of information in computing, represented as a 0 or 1. However, in mathematics, "bit" can be used more generally to refer to a small amount of something, not necessarily related to computing. In Ukrainian, "біт" is commonly used for both meanings, but the context must clarify the intended use.

3. Abbreviations and Acronyms

A major issue in translating technical terms is the use of abbreviations and acronyms, which are often left untranslated, especially when they are widely recognized internationally. These abbreviations may not have standardized translations in Ukrainian, which can lead to inconsistencies in usage.

Example:

CPU (Central Processing Unit) – The abbreviation "CPU" is universally recognized and is often used in Ukrainian texts without translation. In some cases, it is expanded to "центральний процесор," but the abbreviation "CPU" is more commonly used, even in Ukrainian-language texts.

RAM (Random Access Memory) – Similar to CPU, "RAM" is used in its English form, though "оперативна пам'ять" can be used in some contexts. However, "RAM" remains the more widely accepted term, especially in technical discussions [3].

URL (Uniform Resource Locator)

"URL" is a term widely used in both English and Ukrainian, often left untranslated. A more descriptive translation might be "уніфікований локатор ресурсу," but the acronym "URL" remains the dominant term in Ukrainian web-related texts.

GUI (Graphical User Interface)

"GUI" stands for Graphical User Interface, and although it could be translated as "графічний інтерфейс користувача," the abbreviation "GUI" is still commonly used in Ukrainian, particularly in professional and academic settings.

4. Cultural and Linguistic Differences

The linguistic structures of Ukrainian and English can also cause difficulties in translation. English often uses shorter, more compact phrases, while Ukrainian can require longer phrases or additional explanation to convey the same meaning. This discrepancy can result in translations that are either too vague or too complex.

Example:

Interface – In English, the term "interface" can refer to the point where two systems interact, such as a user interface or a hardware interface. In Ukrainian, "інтерфейс" is commonly used as a loanword, but depending on the context, the translation might require additional words like "інтерфейс користувача" (user interface) to clarify the meaning.

Algorithm – While the term "algorithm" is widely used in both English and Ukrainian as "алгоритм," it may require further explanation in specific contexts. In simpler terms, it might be translated as "покрокова інструкція" (step-by-step instruction), but this is not always an accurate reflection of the technical meaning in every situation.

5. Evolving Terminology

The rapid pace of technological advancement means that new terms are constantly being introduced, and it can take time for these terms to be translated and standardized. Some terms may remain in their original English form for years before a suitable translation is found or adopted. This creates a situation where technical texts are a mix of languages, with both English and Ukrainian terms being used interchangeably [3].

Example:

Blockchain – This term has emerged as a key concept in computer science and finance. While the term "блокчейн" is commonly used in Ukrainian texts, a fully Ukrainian equivalent such as "ланцюг блоків" (chain of blocks) has not been widely adopted.

Big Data – "Big Data" is another term that remains largely untranslated, with the term "великий обсяг даних" (large volume of data) being used as a description, but "Big Data" is still preferred in many contexts.

6. Ambiguity and Context-Dependent Meanings

Some terms have multiple meanings in different contexts, which can make translation tricky. The translator must carefully assess the context to choose the appropriate translation.

Examples:

Data

In computer science, "data" refers to information processed by computers. In Ukrainian, it is commonly translated as "дані."

In mathematics, "data" can refer to a set of information used in statistical analysis or experiments. Again, "дані" is used, but the precise nature of the "data" may vary, so the translator needs to adapt based on the surrounding context.

Function

In computer science, a "function" can refer to a block of code that performs a specific task within a program, also translated as "функція." However, it may also be translated as "метод" (method) when referring to object-oriented programming, highlighting the different meanings of the term in each field.

7. Terms with No Clear Equivalent

There are many technical terms that do not have an established or widely accepted Ukrainian translation, and translators often resort to borrowing the term directly from English, adding "transliteration" or creating a descriptive phrase.

Examples:

Bug

"Bug" in the context of computer programming refers to an error or flaw in a software system. It is often kept as "баг" in Ukrainian, though a more descriptive translation could be "помилка програмного забезпечення" (software error). However, "баг" is widely understood and used in everyday language by developers in Ukraine.

Spam

"Spam," referring to unwanted, often unsolicited email, is commonly left untranslated as "спам" in Ukrainian. While "небажана пошта" (unwanted mail) could be an alternative, "спам" is the preferred term, primarily because it is globally recognized.

8. New Technological Terms

As technology advances, new terms are constantly being introduced, and the challenge is to find appropriate translations or decide whether to keep the English terms. Some terms may be used in their English form for a while before a proper translation is accepted or standardized.

Examples:

Startup

The term "startup," referring to a new, often technology-based business, is commonly used in Ukrainian as "стартап," despite the fact that the word "початковий бізнес" (initial business) or "нова компанія" (new company) could describe it. However, "стартап" has become a globally recognized term.

App (Application)

The term "app," short for "application," is widely used in Ukrainian texts, often untranslated as "аплікація" or simply "додаток." While "додаток" (application) is accurate, the use of "app" is frequently preferred due to its widespread use and recognition.

9. Mathematical Terms with Multiple Meanings

Mathematical terms can have different meanings based on context, which makes translation even more challenging. The same word may refer to different concepts in different branches of mathematics or computer science.

Examples:

Matrix

In mathematics, a "matrix" refers to a rectangular array of numbers, symbols, or expressions, typically used in linear algebra. It is translated into Ukrainian as "матриця."

In computer science, "matrix" might also refer to a two-dimensional array or grid, and while "матриця" is also used in this case, translators must ensure that the meaning is clear within the context of a particular field.

Conclusions. Translating English computer science and mathematical terms into Ukrainian presents several challenges, from handling terms with multiple meanings to deciding whether to borrow words directly from English. The rapid evolution of technology and the increasing globalization of the tech industry mean that many English terms remain untranslated or are used in their original form in Ukrainian texts. While this trend makes the translation process more straightforward in some cases, it also requires careful attention to context and accuracy to ensure that the meaning is properly conveyed. Translators must be adept at not only understanding the subject matter but also at striking a balance between linguistic purity and global understandability. Additionally, collaboration with subject-matter experts and adherence to industry standards are essential for ensuring that the translations are accurate, clear, and consistent.

Bibliography:
1. Басснет С. Перекладознавство: Історія, теорія, практика. Київ: Всесвіт, 2005.
2. Гочева Л. В. Проблеми перекладу термінології в галузі інформаційних технологій. Вісник Національного університету «Львівська політехніка». 2018. С. 45–52.
3. Карабан В. І. Посібник-довідник з перекладу англійської наукової і технічної літератури на укр. мову. Tempus, 1997. 260 с.
4. Кочерган М. П. Загальне мовознавство. Київ: Академія, 2003.
5. Огуй О. Д. Лінгвістичні аспекти перекладу термінів у сфері інформаційних технологій. Науковий вісник ЧНУ, 2015. С. 98–107.
6. Паламарчук О. Д. Особливості перекладу комп'ютерної термінології в українській мові. Вісник Харківського національного університету ім. В. Н. Каразіна, 2012. С. 67–74. 2012.

Суїма І. П., Новікова О. В. СКЛАДНОЩІ ПЕРЕКЛАДУ КОМП'ЮТЕРНИХ ТА МАТЕМАТИЧНИХ ТЕРМІНІВ З АНГЛІЙСЬКОЇ МОВИ УКРАЇНСЬКОЮ

Переклад комп'ютерної та математичної термінології представляє значні проблеми через вузькоспеціалізований характер цих галузей, швидкий розвиток технологій і стилістичні відмінності між мовами. Багато технічних термінів походять з англійської мови та не мають прямих еквівалентів, що вимагає від перекладачів вибору між запозиченням оригінального терміну чи створенням описового перекладу. Цей процес ще більше ускладнюється контекстно-залежними значеннями, оскільки багато термінів мають кілька тлумачень залежно від їх використання в різних галузях. Крім того, широке використання абревіатур і акронімів у технічних дисциплінах створює проблеми для узгодженості перекладу, оскільки деякі мови їх локалізують, а інші зберігають англійські версії. Відмінності в граматичних структурах, правилах словотворення та культурних перспективах додатково впливають на те, як технічні концепції адаптуються в різних мовах.

Математична термінологія, хоч і заснована на універсальних символах, у різних мовах відрізняється умовами найменування, що може призвести до неузгодженості у професійному спілкуванні. Постійний розвиток нових технологій вводить нові терміни швидше, ніж стандартні переклади, що призводить до утворення гібридного словника, де англійські терміни співіснують із локалізованими еквівалентами.

У цій статті розглядаються ключові проблеми перекладу комп'ютерної та математичної термінології, аналізується вплив лінгвістичних структур, галузевих стандартів і технологічних досягнень. У статті також обговорюються методи для забезпечення точних, зрозумілих і зручних перекладів, наголошується на важливості співпраці між лінгвістами, технічними експертами та професіоналами галузі. Результати підкреслюють необхідність стандартизованого, але гнучкого підходу до перекладу, який збалансовує ясність, послідовність і доступність у все більш глобалізованому технологійному середовищі.

Ключові слова: переклад, комп'ютерна термінологія, математична термінологія, технічний переклад, лінгвістичні проблеми, запозичення, абревіатури, стандартизация, адаптація термінології, контекстно-залежні значення, галузеві стандарти, локалізація, глобалізація, машинний переклад, багатомовна комунікація.