THE IMPACT OF ARTIFICIAL INTELLIGENCE ON TRANSLATION: CURRENT STATE AND FUTURE PROSPECTS

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Abstract. The rapid advancement of artificial intelligence (AI) technologies, such as neural networks, machine learning, and deep learning, has significantly transformed the field of translation. This article explores the transformative impact of artificial intelligence (AI) on the field of translation, focusing on key AI technologies such as neural networks, machine learning, and deep learning, and their integration into widely used tools like Google Translate and DeepL. Based on critical analysis the study examines how these technologies enhance translation accuracy and efficiency while also highlighting the limitations AI faces in handling cultural nuances, specialized terminology, and context-specific interpretations. The aim of the article is to assess both the positive and negative consequences of AI on the translation profession, addressing questions related to the future of human translators in an AI-driven industry, as well as the ethical concerns surrounding the use of AI in translation. The scientific novelty of this article lies in its comprehensive evaluation of AI technologies in translation, particularly the in-depth analysis of how transformer models like BERT and GPT have advanced the field. It also offers a critical discussion on the balance between AI automation and human oversight in maintaining translation quality. The theoretical significance of this research resides in its contribution to the understanding of AI's evolving role in translation, offering new perspectives on the application of advanced algorithms in language processing. From a practical standpoint, the article provides valuable insights for professional translators, highlighting the new opportunities and challenges AI introduces, especially in terms of specialization, post-editing, and ethical standards.

Keywords: artificial intelligence in translation, neural networks, machine learning, deep learning, transformer models, Google Translate, translation automation, ai and professional translators, ethical issues in ai translation, post-editing in translation

Introduction

Artificial intelligence technologies, particularly neural networks, machine learning, and deep learning, have revolutionized the field of translation by enhancing accuracy and contextual understanding. The implementation of transformer models such as BERT and GPT has enabled more efficient

handling of complex linguistic structures, contributing to more fluid and natural translations.

Prominent AI-based translation systems, including Google Translate, DeepL, and Microsoft Translator, are now integral tools in the industry, offering scalable solutions for text, speech, and image translation. Despite their widespread adoption, these programs exhibit limitations, particularly in the accurate translation of less common languages and context-specific expressions.

The automation of translation processes via AI has generated significant advantages, including increased speed and cost-efficiency. However, it also presents challenges, such as potential loss of cultural nuances and diminished translation quality in specialized fields. Additionally, the integration of AI into translation workflows has redefined the role of professional translators, introducing both threats—such as reduced demand for traditional services—and new opportunities, particularly in areas like post-editing and content adaptation.

Ethical considerations, including issues of algorithmic bias, copyright, and liability, remain critical concerns in the application of AI to translation. While AI offers substantial benefits, its limitations in understanding complex contexts, specialized terminology, and cultural nuances reinforce the need for human oversight, particularly in high-stakes or culturally sensitive translation tasks.

In today's interconnected world, translation is more crucial than ever. As countries grow closer through cultural, economic, and political ties, language barriers remain a significant challenge. Although English is widely used, it does not eliminate the need for translation. Translation serves as a bridge, making information accessible that would otherwise remain beyond reach. Beyond books, translation now spans technical documentation, scientific articles, medical texts, legal papers, and other specialized content, ensuring that communication across various fields remains precise and effective. Moreover, translation fosters intercultural exchange, which is essential in today's era of increasing migration and multicultural societies. It plays a pivotal role in international politics, diplomacy, and business, where accurate translation can make a decisive impact [7].

With the rise of digital technology, the demand for translation has grown exponentially. It is no longer limited to traditional text but extends to web content, mobile applications, games, and other digital products. This evolution has significantly broadened the scope of translation work, making it an indispensable field that continually adapts to the challenges of our modern world.

Artificial intelligence (AI) has quickly become one of the most transformative technologies in recent decades. It involves systems capable of tasks like learning, pattern recognition, decision-making, and natural language processing. Key factors behind AI's growth include increased computational power, the explosion of data, and advancements in machine learning.

AI is being integrated across industries, including translation, where it automates processes, increases efficiency, and lowers costs. Neural networks,

inspired by the human brain, allow AI to "understand" and generate natural language, making it particularly relevant for translation tasks [9].

AI's Impact on Translation

The rapid development of AI is reshaping the translation industry. AI promises faster, cheaper translations, but raises concerns about replacing human translators. It plays a key role in translation technologies like machine translation (MT) and computer-assisted translation (CAT) systems, which improve efficiency and accuracy. Neural machine translation (NMT) systems, using deep learning, have significantly enhanced the quality of translations by considering context, not just word-for-word translation.

Despite these advances, AI has its limitations. It often struggles with context, nuance, and specialized terminology. While it reduces time and costs, it still requires human oversight to ensure the highest quality. AI translations can misinterpret cultural context or idiomatic expressions, leading to errors. For now, human translators are crucial in refining AI outputs and handling complex or specialized texts like legal or medical documents.

Materials and methods

With the help of critical analysis this study seeks to understand how AI affects translation processes, the role of translators, and the quality of translations. Key questions include:

• How does AI change traditional translation processes?

• What are AI's benefits and limitations in translation?

• How does AI influence the role of professional translators?

• How does the quality of AI-generated translations compare to human translations?

• What ethical and legal issues arise from AI in translation?

• What are AI's future prospects in the translation industry?

Results and discussion

Evolution of Translation Technology

The history of translation technology is marked by significant milestones. Early attempts in the mid-20th century focused on rule-based systems like the Georgetown-IBM experiment (1954), but these methods were limited in scope. In the 1990s, statistical machine translation (SMT) took over, relying on large parallel corpora and probabilistic models to improve translation quality.

A major shift occurred in the 2010s with the rise of neural machine translation (NMT). Unlike SMT, NMT models use deep learning to enhance translation by considering context, not just individual words. The introduction of the "attention mechanism" in 2014 allowed NMT models to analyze entire sentences more accurately. This approach significantly improved translation quality, and models like Google Translate and DeepL are based on these innovations.

The 2017 introduction of the transformer model revolutionized translation even further. Transformers, described in the paper "Attention is All You Need" (Vaswani et al., 2017), use attention mechanisms to handle long-range dependencies in sentences, resulting in higher accuracy and more natural-sounding translations. Systems based on transformers, such as GPT and BERT, continue to set new standards for AI-driven translation [3, p. 45].

AI Achievements and Limitations in Translation

AI technologies, especially neural networks and transformers, have led to significant improvements in translation accuracy and naturalness. These models can handle long text dependencies, providing more coherent and contextually appropriate translations. They have also enabled better handling of rare and complex languages, where resources are limited. AI-powered platforms like Google Translate and DeepL offer real-time, high-quality translations integrated into various applications, making translation more accessible to a global audience.

However, despite these achievements, AI still struggles with several challenges. Context and nuance are often misinterpreted, leading to errors in meaning, especially in culturally specific or idiomatic phrases. Specialized texts, like legal or medical documents, present difficulties as AI systems may fail to capture the precision required. Bias in AI training data is another concern, potentially leading to unfair or inaccurate translations, particularly regarding gender, culture, or social stereotypes.

Moreover, AI systems require vast amounts of data and computational resources, limiting their accessibility to smaller organizations. Another issue is the need for frequent updates to adapt to evolving languages, as models can quickly become outdated without retraining. This suggests that while AI translation has advanced, it is not yet a complete replacement for human translators [1, p. 8].

AI's Influence on Professional Translators

The rise of AI in translation poses both challenges and opportunities for professional translators. On the one hand, AI-driven tools have decreased the demand for traditional translation services, particularly for simple, repetitive tasks. AI can automate standard translations, reducing the need for human input and creating competitive pressure due to lower costs.

However, AI also opens doors for collaboration between machines and human translators. Translators can use AI as a tool to enhance their work, focusing on refining translations and addressing complex linguistic or cultural nuances that AI systems might miss. Specialization in fields such as legal, medical, or technical translation remains essential, as AI struggles to manage the specificity and accuracy required in these domains.

Translators who adapt to working with AI can benefit from increased efficiency and productivity. They can focus on higher-level tasks like localization, adaptation, or post-editing, where human insight is critical. Additionally, mastering new AI tools and software can enhance their skill set, making them more competitive in the evolving job market [10].

Quality of AI Translations: Successes and Gaps

The quality of AI-generated translations has significantly improved, especially in terms of sentence structure and naturalness. Neural networks and transformer-based models like BERT and GPT excel at producing translations that sound more fluent and coherent. These systems are also capable of handling longer text segments, ensuring better context preservation and reducing the need for post-editing.

However, despite these improvements, AI translations still suffer from notable gaps. AI often struggles with idiomatic expressions, cultural references, and specialized terminology. Contextual errors are common, especially when translating ambiguous phrases or words with multiple meanings. AI can also introduce biases, particularly in gendered languages or when dealing with sensitive topics. These limitations indicate that while AI translations are useful, they still require human oversight and post-editing to achieve the desired quality [8, p. 30].

Ethical and Legal Considerations in AI Translation

The increasing use of AI in translation raises significant ethical and legal issues. One of the primary concerns is copyright. Translations are considered derivative works, meaning the original content's copyright must be respected. When using AI for translation, it is crucial to ensure compliance with intellectual property laws, especially regarding ownership of both the source and translated content. Responsibility for translation errors is another concern. Since AI is prone to mistakes, particularly in context or cultural nuances, the ultimate responsibility for ensuring translation accuracy often falls on the human translator or organization using the AI tool.

Transparency is another ethical issue. Clients should be informed if a translation is generated using AI, ensuring clear expectations about the quality and potential limitations of the output. AI systems can also inherit biases from their training data, reflecting societal stereotypes or biases related to gender, race, and culture. Efforts to reduce bias in AI models are essential to ensure fair and accurate translations.

Lastly, data privacy is a critical issue. Many AI models require large amounts of data to train and function effectively, which may include sensitive information. Ensuring that data is handled securely and in compliance with privacy regulations is crucial, particularly when translating confidential documents such as legal or medical texts [5, p. 2].

AI vs. Human Translators: Can AI Replace Them?

While AI has made great strides in translation, it cannot fully replace human translators. Current AI systems are highly effective for routine tasks, such as translating basic or structured texts. They can process vast amounts of data quickly, making them suitable for general communications, websites, or customer service tasks. However, AI still struggles with complex tasks that require a deep understanding of context, culture, and language nuances.

Human translators are still essential for more creative, nuanced, and specialized tasks. For instance, literary translation, marketing materials, and legal documents often require cultural sensitivity and the ability to interpret subtleties that AI cannot fully grasp. Furthermore, AI systems lack the flexibility to adapt to rapidly changing language trends or handle unique linguistic challenges that arise in specialized fields. Human translators provide the critical thinking and expertise needed for these tasks, ensuring the highest quality.

Therefore, the future of translation will likely involve collaboration between AI and human translators. AI will handle routine or repetitive tasks, while human translators will focus on refining and enhancing the output, especially in complex or creative areas [13].

Ethical Dilemmas in AI Translation

AI translation presents several ethical dilemmas. Algorithmic bias is a key issue, as AI models trained on biased data can reflect and perpetuate these biases in their translations. For example, gendered language or cultural stereotypes may be inaccurately conveyed in AI-generated translations, leading to misrepresentations or discrimination. Efforts to reduce such biases are critical, but they require continuous monitoring and improvement.

Another dilemma is data privacy. AI systems rely on large datasets for training, often including sensitive or confidential information. Translators and organizations must ensure that data is handled securely and in accordance with legal requirements, such as the General Data Protection Regulation (GDPR).

Moreover, the increasing use of AI raises concerns about job displacement. As AI systems become more sophisticated, there is a risk that human translators will face reduced demand for their services, particularly in low-level translation tasks. This highlights the need for translators to adapt by developing new skills, such as post-editing AI translations or specializing in areas where human expertise is still indispensable [12].

AI technologies have greatly improved translation accuracy and efficiency, yet they still face notable limitations, particularly in handling cultural nuances, specialized terminology, and context-specific interpretations. Now let's look at some specific examples that illustrate these points.

Enhanced Accuracy and Efficiency:

• Neural Machine Translation (NMT):NMT models, like those employed by **Google Translate** and **DeepL**, enhance translation quality by considering entire sentence contexts rather than translating word-for-word. For instance, in translating everyday phrases or conversational language, NMT can produce more fluent and accurate translations, significantly reducing the time needed for large-scale translation tasks. This leads to improved efficiency, especially for routine or high-volume projects.

• Machine Learning and Automation:

AI-driven translation systems, such as **Microsoft Translator**, learn from extensive databases of translated texts. This allows them to rapidly process

translations, handling repetitive tasks far faster than human translators. For example, AI can instantly translate website content or user instructions, increasing overall productivity and reducing costs for businesses.

Limitations in Cultural Nuances:

• Idiomatic Expressions:

AI often encounters difficulties when dealing with idiomatic expressions that are deeply rooted in specific cultures. For example, the English idiom "it's raining cats and dogs" might be translated literally into another language, losing its intended meaning entirely. While a human translator would understand the need to replace this phrase with a culturally equivalent expression, AI tends to struggle with such nuances, often leading to misinterpretation.

• Humor and Sarcasm:

Complex language elements like humor and sarcasm also pose challenges for AI

systems. For instance, sarcasm in statements such as "Oh, great job!" could be incorrectly translated as a genuine compliment, as AI often lacks the cultural and contextual awareness to detect the speaker's intent. Human translators, conversely, are better equipped to grasp and translate these subtle elements accurately.

Limitations in Specialized Terminology:

• Technical and Legal Texts:

AI systems can falter when tasked with translating highly specialized terminology, such as that found in legal or technical documents. For example, in legal contexts, the term "consideration" has a specific meaning in contract law. An AI translator might misinterpret it as a general term meaning "thoughtfulness" or "deliberation," resulting in inaccuracies that could be significant in legal settings.

• Scientific   Texts:

Similarly, AI can struggle with the precise translation of scientific language. For instance, a phrase like "gene expression" could be translated incorrectly if the AI lacks sufficient understanding of the specific scientific context, potentially leading to errors in specialized fields where exact terminology is critical.

Limitations in Context-Specific Interpretations:

• Ambiguity in Language:

AI often fails to resolve ambiguities in sentences where multiple interpretations are possible. For example, the English word "bank" could refer to either a financial institution or the side of a river. Without clear context, AI might select the wrong meaning, leading to translation errors. Human translators, by contrast, can discern the correct meaning based on a deeper understanding of context.

• Gender Pronouns in Language:

In languages with grammatical gender, such as**Russian,** AI systems may struggle to accurately translate gender-neutral terms or pronouns. For example, translating the sentence "they are a student" into Russian might result in either the

masculine **"он студент"** or the feminine "**она студентка,**" depending on how the AI interprets the subject's gender, which may not always be clear. Such errors underscore the need for human intervention in ensuring precise translations in gendered languages [2, p. 990].

Future Prospects of AI in Translation

The future of AI in translation is poised for further innovation and integration with other emerging technologies. One area of potential growth is deeper contextual understanding. Current AI models are good at processing simple text, but future systems will aim to better grasp complex contexts, including cultural nuances and specialized terminology. This would lead to more accurate and reliable translations, especially in fields such as legal, medical, and technical translations.

Another likely development is the integration of AI translation with other advanced technologies like augmented reality (AR) and virtual reality (VR). This integration could allow users to experience real-time, immersive translation in various environments, such as during live events, in interactive games, or in multilingual workplaces.

AI translation systems are also expected to become more personalized. Future models could adapt translations based on user preferences, historical data, or specific industry requirements, offering more tailored and precise outputs. Furthermore, AI will continue to expand its support for more languages, including rare and minority languages, improving accessibility and communication across different regions.

Ethical and legal regulation will also become increasingly important as AI technologies evolve. The focus will shift toward establishing clearer guidelines on data privacy, algorithmic bias, and intellectual property. As AI systems improve, human translators will play a collaborative role, using AI to enhance their productivity and focusing on complex tasks that require human insight [4, p. 21].

Key Findings and Recommendations

AI has transformed the translation industry by significantly improving translation accuracy and efficiency. Neural networks and transformer models have elevated the quality of automated translations, allowing for better handling of context, sentence structure, and a wider range of languages. However, despite these advancements, AI cannot fully replace human translators. The subtleties of language—such as cultural nuances, idiomatic expressions, and specialized knowledge—are still areas where human expertise is essential.

For translators, the key to future success lies in adapting to technological changes. Professionals who learn to work with AI tools will enhance their productivity, while those who specialize in fields requiring deep contextual understanding, like legal or medical translation, will continue to be in demand. Continuous education and the development of new skills in post-editing AI translations, cultural adaptation, and technology use will be crucial.

Ethical and legal issues surrounding AI, including bias, responsibility for errors, and data privacy, will need ongoing attention. Translators and organizations should work together to develop standards and best practices that ensure ethical AI use in translation. Maintaining transparency with clients about the use of AI and balancing machine-generated translations with human expertise will be key to preserving trust and quality [11].

Conclusion

AI in translation has revolutionized the field, making translation faster, more scalable, and accessible to a broader audience. While AI excels in automating routine translation tasks, it still has significant limitations when dealing with nuanced, context-heavy, or specialized texts. Human translators remain indispensable for tasks that require deep understanding, cultural sensitivity, and creativity.

The future of translation will involve a partnership between AI and human professionals. AI will continue to evolve, improving its contextual and linguistic abilities, while human translators will focus on refining and elevating AI outputs, ensuring quality and precision in areas where machines fall short. Ethical considerations, such as bias and data privacy, will remain critical as AI becomes more deeply embedded in the industry.

Translators who embrace new technologies, continually develop their skills, and specialize in areas requiring human expertise will thrive in this changing landscape. The key to success will be balancing the strengths of AI with the irreplaceable insights that only human translators can provide.

Potential Changes in the Translation Profession

With the rise of AI technologies, the translation profession is evolving. Translators will increasingly shift from traditional translation tasks to roles involving post-editing AI-generated translations. This includes correcting errors, improving stylistic choices, and ensuring accuracy, especially in complex or specialized texts. Translators will also need to specialize in niche areas like legal, medical, or technical translation, where deep subject knowledge and attention to detail are critical, areas where AI struggles.

Technological literacy will become essential for translators, requiring them to master AI tools, computer-assisted translation (CAT) software, and project management technologies. Working with large datasets, interpreting AI output, and helping optimize translation models may become part of a translator's job. Flexibility in work processes is also anticipated, as remote work and collaboration across different tools become more common.

Professional development will be crucial, with translators needing to continuously improve their skills, attend training sessions, and stay updated with technological advancements. The profession will likely see the creation of new roles, such as AI post-editors and consultants, who help bridge the gap between human expertise and machine translation output.

Finally, translators will need to address ethical challenges, such as data privacy and bias in AI translations. They will play a key role in managing the balance between AI-generated translations and the human touch, ensuring that quality, fairness, and ethical considerations are upheld [6].

General Conclusions and Recommendations for the Field of Translation

Importance of AI in Translation: AI has become a critical tool in translation, especially for handling large volumes of text quickly and cost-effectively. However, it still lacks the ability to fully understand context, cultural nuances, and specialized terminology, making human translators essential for high-quality results.

Adaptation to New Technologies: Translators must embrace AI tools and learn to work with them effectively. This includes using AI to automate simple tasks, while focusing their efforts on more complex and creative aspects of translation, such as post-editing and localization.

Ethical and Legal Considerations: As AI becomes more integrated into translation workflows, ethical issues like data protection, bias, and responsibility for errors will require careful attention. Developing clear standards and regulations for AI use in translation will help ensure that ethical and professional guidelines are maintained.

Continuous Professional Development: Translators need to commit to lifelong learning, staying updated with the latest translation technologies and methods. Specialization in niche areas will also remain crucial for those looking to maintain a competitive edge in the industry.

Human-AI Collaboration: The future of translation will be defined by collaboration between human translators and AI systems. AI will handle routine tasks, while human professionals focus on refining, adapting, and ensuring the accuracy of translations. Maintaining a balance between automated and human contributions will be key to success.

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ЖАСАНДЫ ИНТЕЛЛЕКТТІҢ АУДАРМАҒА ӘСЕРІ: ҚАЗІРГІ ЖАҒДАЙЫ ЖӘНЕ БОЛАШАҒЫ

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Аңдатпа. Нейрондық желілер, Машиналық оқыту және терең оқыту сияқты жасанды интеллект (AI) технологияларының қарқынды дамуы аударма саласын айтарлықтай өзгертті. Бұл мақалада жасанды интеллекттің (AI) аударма саласына трансформациялық әсері зерттеледі, нейрондық желілер, Машиналық оқыту және терең оқыту сияқты негізгі AI технологияларына және оларды Google Translate және DeepL сияқты

кеңінен қолданылатын құралдарға біріктіруге баса назар аударылады. Зерттеу бұл технологиялардың аударманың дәлдігі мен тиімділігін қалай арттыратынын қарастырады және мәдени нюанстармен, мамандандырылған терминологиямен және контекстке байланысты интерпретациялармен жұмыс істеу кезінде жасанды интеллекттің шектеулеріне баса назар аударады. Мақаланың мақсаты-жасанды интеллект басқаратын индустриядағы адам аудармашыларының болашағына қатысты мәселелерді, сондай-ақ аудармада жасанды интеллектті қолданумен байланысты этикалық мәселелерді қозғай отырып, аударма кәсібіне жасанды интеллекттің оң және теріс әсерін бағалау. Бұл мақаланың ғылыми жаңалығы аудармадағы жасанды интеллект технологияларын жан-жақты бағалауда, атап айтқанда BERT және GPT сияқты трансформаторлық модельдердің бұл саланы қалай алға жылжытқанын терең талдауда жатыр. Ол сондай-ақ аударма сапасын сақтай отырып, жасанды интеллектті автоматтандыру мен адам бақылауы арасындағы тепе-теңдікті сыни талқылауды ұсынады. Бұл зерттеудің теориялық маңыздылығы оның тілдік деректерді өңдеуде озық алгоритмдерді қолданудың жаңа перспективаларын ұсына отырып, аударма процесінде жасанды интеллекттің дамып келе жатқан рөлін түсінуге қосқан үлесі болып табылады. Практикалық тұрғыдан алғанда, мақалада кәсіби аудармашылар үшін құнды ақпарат бар, жасанды интеллект ашатын жаңа мүмкіндіктер мен мәселелерді, әсіресе мамандандыру, редакциялаудан кейінгі және этикалық стандарттар тұрғысынан қарастырады.

Тірек сөздер: аудармадағы жасанды интеллект, нейрондық желілер, машиналық оқыту, тереңдетіп оқыту, трансформаторлық модельдер, Google Translate, аударманы автоматтандыру, жасанды интеллект, кәсіби аудармашылар, жасанды интеллект аудармасындағы этикалық мәселелер, аудармадағы кейінгі редакциялау

ВЛИЯНИЕ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА НА ПЕРЕВОД: ТЕКУЩЕЕ СОСТОЯНИЕ И ПЕРСПЕКТИВЫ

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Аннотация. Стремительное развитие технологий искусственного интеллекта (ИИ), таких как нейронные сети, машинное обучение и deep learning, значительно изменило сферу перевода. В этой статье исследуется преобразующее влияние искусственного интеллекта (ИИ) на сферу перевода, особое внимание уделяется ключевым технологиям ИИ, таким как нейронные сети, машинное обучение и deep learning, а также их интеграции в широко используемые инструменты, такие как Google Translate и DeepL. В исследовании рассматривается, как эти технологии повышают точность и эффективность перевода, а также подчеркиваются

ограничения, с которыми сталкивается искусственный интеллект при работе с культурными нюансами, специализированной терминологией и интерпретациями, зависящими от контекста. Цель статьи - оценить как положительные, так и отрицательные последствия ИИ для переводческой профессии, затронув вопросы, связанные с будущим переводчиков-людей в индустрии, управляемой ИИ, а также этические проблемы, связанные с использованием ИИ в переводе. Научная новизна этой статьи заключается во всесторонней оценке технологий искусственного интеллекта в переводе, в частности, в глубоком анализе того, как трансформаторные модели, такие как BERT и GPT, продвинули эту область вперед. В ней также предлагается критическое обсуждение баланса между автоматизацией ИИ и контролем со стороны человека при поддержании качества перевода. Теоретическая значимость этого исследования заключается в его вкладе в понимание эволюционирующей роли искусственного интеллекта в процессе перевода, предлагая новые перспективы применения передовых алгоритмов в обработке языковых данных. С практической точки зрения, статья содержит ценную информацию для профессиональных переводчиков, освещая новые возможности и проблемы, которые открывает искусственный интеллект, особенно в плане специализации, постредактирования и этических стандартов.

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