Artificial Intelligence In Translation Studies: Benefits, Challenges, And Future Directions

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Abstract

This review paper gives an overview analysis of the function of artificial intelligence (AI) in translation studies (TS). It examines four primary AI translation models: statistical machine translation, rule-based machine translation, neural machine translation, and hybrid machine translation. It evaluates the effectiveness of each version and explores its strengths and weaknesses, especially in handling figurative language (e.g., idioms, metaphors) and cultural nuances. The paper similarly explores avenues for boosting the performance of AI-based translation systems. Moreover, it addresses the moral and societal ramifications of AI in translation, encompassing problems related to AI representation in disciplines like literature and the arts. The paper also examines AI's capability impact on the interpretation profession, such as the demanding situations, opportunities, and dangers posed by AI-based translation, especially concerning professional obstacles, data privacy, and bias. Based on this analysis, the paper proposes recommendations for the current and future directions of AI in the field of translation.

Keywords: *AI, Benefits, Challenges, Future directions, Translation Studies*

الذكاء الاصطناعي في دراسات الترجمة: المميزات والتحديات والاتجاهات المستقبلية

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المستخلص

تقدم هذه الورقة البحثية وصفا تحليلًا لوظيفة وأهمية الذكاء الاصطناعي (AI) في دراسات الترجمة (TS). وتتناول الدراسة أربعة نماذج أساسية لترجمة الذكاء الاصطناعي: الترجمة الآلية الإحصائية، والترجمة الآلية القائمة على القواعد، والترجمة الآلية العصبية، والترجمة الآلية الهجينة. ومن ثم تقييم فعالية كل نموذج واستكشاف نقاط القوة والضعف فيه، خاصة في التعامل مع اللغة المجازية (مثل التعابير والاستعارات) والفروق الثقافية الدقيقة. وتستعرض الورقة أيضا سبل تعزيز أداء أنظمة الترجمة القائمة على الذكاء الاصطناعي. علاوة على ذلك، فهو يتناول التداعيات الأخلاقية والمجتمعية للذكاء الاصطناعي في الترجمة، بما في ذلك المشكلات المتعلقة بتمثيل الذكاء الاصطناعي في تخصصات مثل الأدب والفنون. كما تبحث الورقة في تأثير قدرة الذكاء الاصطناعي على مهنة الترجمة الفورية، كذلك المواقف الصعبة والفرص والمخاطر التي تشكلها الترجمة القائمة على الذكاء الاصطناعي، خاصة فيما يتعلق بالعقبات المهنية وخصوصية البيانات والتحيز. وبناءً على هذا التحليل، تقترح الورقة البحثية توصيات بشأن التوجهات الحالية والمستقبلية للذكاء الاصطناعي في مجال الترجمة.

الكلمات المفتاحية: *الذكاء الاصطناعي، المميزات، التحديات، التوجهات المستقبلية، دراسات الترجمة*

Introduction:

Artificial intelligence (AI) in the field of translation studies (TS) includes the development and use of computer programs to automate the language translation process. Since the inception of the profession in the mid-20th century, the field has evolved dramatically from rule-based methods to data-driven statistical methods and more recently in neural network-based approaches. Early research on AI-based translation (Hutchins, 2000) focused on rule-based machine translation (RBMT), which relied on pre-defined linguistic rules and dictionaries for translation, but these systems struggled with complex language structure and idiomatic vocabulary. Limitations have resulted in accuracy and fluency. The 1990s saw the advent of statistical machine translation (SMT), a paradigm shift that used statistical models to identify translation patterns from large bilingual firms. This approach proved more robust than RBMT and led to improvements as it distinctly came into translation efficiency (Brown et al., 1990). In recent years, neural machine translation (NMT) has emerged as a dominant technique, which uses deep neural networks to recognise complex language representations and provide translations that are often indistinguishable from text produced by humans have been developed (Sutskever et al., 2014). NMT has shown remarkable progress in capturing nuances of language and producing more natural and smooth translations. The implications of AI for TS are profound. Furthermore, these programs can significantly reduce and expand human translation costs. This review paper provides a comprehensive overview of AI in TS, examining the use of different methods and models, their effectiveness, and their challenges. The paper also focuses on AI in the future of the translation industry.

Literature review

Artificial Intelligence (AI) has significantly influenced the field of translation, where AI-based research methods are widely used in real-world applications. Artificial intelligence (AI) techniques used in translational studies (TS) are widely referred to as statistical machine translation (SMT), rule-based machine translation (RBMT), neural machine translation (NMT), and hybrid machine translation (known as HMT) (Koehn & Knowles, 2017; Koehn, 2020). SMT uses mathematical models to analyze translation patterns from large bilingual groups (Dugonik et al., 2023). While effective, SMT models can struggle with complex sentence structure and idiomatic vocabulary. RBMT relies on predefined grammar rules and dictionaries to produce translations. RBMT excels in dealing with complex systems, providing a controlled and scalable semantic framework (Srilekha et al., 2018). However, its functionality is limited by high-level dictionaries and grammar rules. NMT uses deep neural networks to recognize complex speech representations and provides remarkable improvements in capturing subtle speech patterns and idioms (Vaswani et al., 2018). NMT is more efficient in terms of translation accuracy, slowness and efficiency compared to other methods (Koehn & Knowles, 2017; Koehn, 2020; Potdar, 2023). However, NMT requires extensive training data and computer resources. HMT combines the power of statistical rule-based methods with neural networks with the aim of achieving optimal semantics. While promising, HMT is still under development and requires further investigation.

Furthermore, the integration of Artificial Intelligence (AI) in the area of translation offers both full-size advantages and demanding situations. A primary gain is the improved translation of large volumes of content material. Advancements in neural system translation (NMT) have substantially increased the accuracy and fluency of translations, making them increasingly reliable for ordinary use (Sutskever et al., 2014). In addition, AI translation gear provides skillability, enabling simultaneous translation across more than one language pair (Bojar et al., 2017). Despite these advancements, AI translation faces several challenges. Notably, system translations regularly lack the cultural nuances and context-specific meaning that human translators excel at capturing (O'Brien, 2021). The hazard of bias remains a difficulty as AI structures analyze from present records, which may be inherently inspired by diverse views or stereotypes (Caliskan et al., 2017). Ensuring privacy and information security is another challenge that can be accomplished when utilizing 0.33-celebration translation carriers employing AI technology (Schäfer, 2018).

Thus, even as AI has undeniably revolutionized translation approaches in terms of performance, it is essential to understand the constraints of AI and the ongoing importance of human translators in retaining accuracy and cultural sensitivity in translation (Baker, 2011).

Representation of AI in literature

The pervasive effect of artificial intelligence (AI) on modern-day society is contemplated in its growing illustration inside literary works. Fiction regularly makes use of AI as a story tool to explore existential questions and moral dilemmas posed by the combination of shrewd machines in human life (Britannica, 2024). Isaac Asimov's seminal paintings, "The Three Laws of Robotics," brought the idea of ethical hints for robotic conduct, emphasising the importance of setting up ethical frameworks for AI improvement (Britannica, 2024). Philip K. Dick's "Do Androids Dream of Electric Sheep?" delves into the complicated difficulty of defining human identification in a world where AI entities blur the lines between human and artificial beings (Dick, 2014). Contemporary fiction, inclusive of Ian McEwan's "Machines Like Me," examines the multifaceted nature of AI-human relationships, exploring subject matters of love, morality, and authenticity (McEwan, 2019). By portraying AI in fictional narratives, authors now not only effectively reflect the evolving dating between human beings and generations but additionally utilise AI as a lens to scrutinise the very essence of humanity in the face of rapid technological improvements.

Representation of AI in Arts

Integrating artificial intelligence (AI) into the arts has brought new paradigms of artistic creation, blurring the traditional distinction between human and machine writing. Designers increasingly use AI to create new visual and audio-stimulating experiences (Liu, 2023).

AI systems are used to create complex art that challenges traditional notions of composition and aesthetic representation, pushing the boundaries of artistic expression (Deng & Chen, 2021). AI in music is collaborating with musicians to create new sonic experiences, expanding the boundaries of musical possibilities (Zhang & Lu, 2021). AI-generated poetry and literature raise fundamental questions about the nature of thought and the essence of creativity (Miller, 2019). This dynamic development of AI in design indicates the possibility of technology working with human intelligence (Zhang & Lu, 2021), ultimately redefining the design concept and allowing AI to compel us to explore the limitless potential at the intersection of technology and imagination.

AI Academic Prospects

Artificial intelligence (AI) provides a widespread and transformative panorama of instructional opportunities (Soori, 2023). The speedy evolution of AI incorporates a wide variety of disciplines, including gadget learning, deep getting-to-know, herbal language processing, robotics, and more, providing numerous avenues for research and exploration (Soori, 2023). Researchers and teachers are actively engaged in investigating the complexities of developing AI algorithms that can emulate human intelligence, leading to capacity programs across numerous fields, together with healthcare, economics, training, and amusement (Alami et al., 2020). Within Translation Studies (TS), AI opens a realm of intriguing instructional opportunities (MuñozBasols et al., 2023). AI technologies, especially machine translation (MT) and natural

language processing, are revolutionizing the strategies of language identification, interpretation, and communique (MuñozBasols et al., 2023). Researchers are investigating the use of AI-driven gear and algorithms to enhance the precision and performance of translation techniques, bridging linguistic obstacles across cultures and industries (Abioye et al., 2021). As AI continues its rapid development, its effect on translation research provides a compelling area for academic inquiry and innovation, basically reshaping our understanding and engagement with languages and cultures.

Challenges:

Despite tremendous advancements in AI-based translation, numerous challenges and obstacles persist, hindering the full awareness of its ability to revolutionise go-lingual conversation (Kenny, 2018). One outstanding impediment is the inherent issue of capturing cultural nuances within translated texts. While maintaining cultural context, humour, and diffused meanings is essential in many translation scenarios, AI translation structures often conflict in dealing with these complexities (Kenny, 2018) correctly. For example, an AI machine could possibly translate an English comic story into Japanese in a way that fails to elicit humour among Japanese speakers, or it could render a cultural allusion to any other language that lacks relevance to the target market. The structural and syntactic differences between languages pose substantial challenges for system translation (MT) models (Sayle, 2009). He highlighted the difficulties of translating chemical nomenclature, emphasising the need for skillability within the latest terminology of each source

and goal language, in addition to the cultural and historical significance of the names. Additionally, translating idioms, metaphors, and cultural nuances, mainly inside low-resource languages in which training facts are restricted, can seriously impact the accuracy of translations (Koehn, 2017).

The widespread adoption of AI-based translation systems increases privacy and protection issues, especially when dealing with sensitive or confidential substances (Borkert et al., 2018). AI structures, because of their reliance on big datasets for education and operation, can also inadvertently access and manipulate sensitive records, including change secrets, private statistics, and financial facts (Borkert et al., 2018).

Hartmann (2023) argues that the improvement of AI-based Ambient Assisted Living (AAL) systems regularly overlooks the importance of freedom and privateness for elderly people and people with disabilities. Some AAL systems acquire and store substantial personal data, doubtlessly compromising user privacy. These worries highlight the moral implications of AI systems, particularly in healthcare settings (Hartmann, 2023). Bias and fairness concerns must be taken into consideration while developing and deploying AI systems, especially when it comes to translation models (Prates et al., 2020; Pessach & Shmueli, 2022). According to Prates et al. (2020), the unintentional transfer of biases from training data to translations presents moral quandaries and may exacerbate preexisting societal biases. Translation algorithms that exhibit bias in language selection may give preference to specific dialects or regional idioms over others. When translating gender-neutral

statements, Prates et al. (2020) found that Google Translate tended to favour the male gender, rendering "The doctor is a kind person" to "The doctor is a kind man." Additionally, the authors discovered that Google Translate frequently translates words that promote gender stereotypes, such as "The nurse is a kind woman" instead of "The nurse is a caring person" (Prates et al., 2020). With an emphasis on applications in healthcare, Pessach and Shmueli (2022) presented a framework for gauging fairness in machine translation. Because of the complexities and subtleties involved, evaluating AI translations and creating efficient quality control techniques are challenging (Vela-Valido, 2021). It is challenging to evaluate AI translations objectively because of the subjectivity involved in judging translation quality and the complexity of language. Although AI translation models are highly proficient in generating translations that nearly exactly match source materials, they frequently encounter difficulties in effectively communicating the intended meaning. Due to this constraint, new assessment metrics that take into account the nuances of meaning, fluency, and cultural appropriateness, in addition to lexical congruence, must be investigated and developed (Vela-Valido, 2021). In their investigation of the relationship between corporate communications and translation quality assurance, Massey and Wieder (2019) noted the growing usage of translations in risky fields, including business, law, and healthcare. It is crucial to guarantee translations' precision, reliability, and cultural suitability in these situations (Massey & Wieder, 2019).

Fostering successful cooperation between AI technologies and human translators is a crucial challenge in the translation industry

(Weisz et al., 2021). It takes a careful and adaptable strategy that strikes a compromise between the special talents of human linguists and the capabilities of AI models in order to produce high-quality translations that are accurate, culturally nuanced, and contextually relevant. In the context of code translation, Weisz et al. (2021) investigated the opportunities and difficulties of human-AI collaboration. Their research showed that, despite their limitations, AI code translation tools can be a useful supplement to human translators, especially when used in tandem. AI systems can translate code into a greater variety of languages and far faster than humans.

The Future of AI in the Translation Industry:

New developments are influencing how cross-lingual communication may develop in the future in the field of AI-based Translation Studies (TS), which is advancing quickly (Lample et al., 2018; Klein, 2008; Dajun & Yun, 2015; Barrault et al., 2023; Yao & Wan, 2020). Sophisticated multilingual and multimodal translation models that can handle various language types, such as text, audio, and visuals, are one popular trend (Lample et al., 2018; Barrault et al., 2023; Yao & Wan, 2020). Language translation skills can be learned without the need for parallel training data by using Unsupervised Machine Translation (UMT) models, as the ones put forth by Lample et al. (2018). Using unsupervised learning strategies, these models can learn from unannotated data and become less reliant on substantial training datasets (Klein, 2008).

The development of Corpus-Based Machine Translation (CBMT), which develops translation models using sizable parallel and monolingual text corpora, is another noteworthy trend (Dajun &

Yun, 2015). A cutting-edge machine translation (MT) model called SeamlessM4T was presented by Barrault et al. (2023) that can translate text, audio, and visuals across 264 different languages. After being trained on an extensive dataset that includes text, audio, and image data, SeamlessM4T performs remarkably well on several machine translation benchmarks. Its functions include interpreting movie and video subtitles and enabling multilingual speakers to converse in real-time (Barrault et al., 2023). In a similar vein, Yao and Wan (2020) presented a Multimodal Machine Translation (MMT) model that improves the quality of translated text by integrating visual information from input images.

It is anticipated that hybrid approaches that skillfully combine the advantages of AI and human translators will define the future of translation methodology (Costa-Jussa & Fonollosa, 2015; Dhariya et al., 2017; Narayan & Gardent, 2014; Vela-Valido, 2021). Utilising the unique benefits of each will be the main goal (Costa-Jussa & Fonollosa, 2015; Dhariya et al., 2017; Narayan & Gardent, 2014; Vela-Valido, 2021). These advantages are the accuracy and efficiency of AI algorithms paired with the creative and nuanced understanding of human translators.

Statistical machine translation (SMT)-guided HMT that integrates linguistic principles (Costa-Jussa & Fonollosa, 2015), Rule-Based Machine Translation (RBMT) systems that incorporate corpus-based data (Costa-Jussa & Fonollosa, 2015), and hybrid SMT that combines various SMT methods, such as phrase-based SMT and n-gram SMT (Costa-Jussa & Fonollosa, 2015) are examples of hybrid approaches. Dhariya et al. (2017) suggested a hybrid technique

combining RBMT and SMT for Hindi and English translation, showing better performance than separate RBMT and SMT models. A hybrid approach to sentence simplification, based on semantic representation instead of conventional structures like sentences or parse trees, was developed by Narayan and Gardent (2014). This method merges deep semantics with machine translation. Collaboration between AI and human content specialists will become increasingly important as technology develops, promoting a more integrated and effective approach to language translation (Vela-Valido, 2021). These hybrid approaches—which maximise the translation process through dynamic synergy—are anticipated to proliferate (Vela-Valido, 2021). Additionally, as natural language processing advances, AI translation models will be driven to improve their competency in low-resource languages and dialects in order to bridge linguistic gaps. This helps to preserve minority languages and guarantees a more thorough and readily available translation service (Lakew et al., 2018; Gu et al., 2018; Agić et al., 2016; Zhao & Jiang, 2022). Lakew et al. (2018) addressed the problem of insufficient parallel data for building reliable bilingual NMT models by proposing a multilingual Neural Machine Translation (NMT) technique for low-resource languages. Using a small corpus of 6,000 words, Gu et al. (2018) demonstrated the efficacy of a novel neural machine translation (NMT) approach for languages with sparse parallel data. Agić et al. (2016) created a novel technique that translates explanations from a high-resource language to a low-resource language through dependency parsing and cross-lingual part-of-speech tagging. Using a dataset of 105

languages, many of which had little to no annotated information, the authors tested their methodology. Zhao and Jiang (2022) presented a system that combines Quantum Particle Swarm Optimisation (QPSO) and Convolutional Neural Network (CNN) to improve English translation skills for several users simultaneously. The QPSO technique optimises the CNN parameters, and the trained CNN uses the English translation data to extract features.

A regression model that forecasts each user's level of English translation competency is trained using these retrieved features. Moving away from traditional techniques and towards a more dynamic, AI-powered future, these trends mark a paradigm shift in the language translation industry.

Moreover, Multilingual content creation is becoming a part of the future of AI in language-related jobs, going beyond standard translation (Gambier, 2016). The creation of varied information, such as multilingual documentation, audiovisual translation, and localised materials, is about to undergo a revolution thanks to AI algorithms (Gambier, 2016). This paradigm shift streamlines content development for global audiences by positioning AI as more than just a translation tool (Gambier, 2016). According to Bernardini et al. (2020), incorporating AI enables swift content creation while maintaining uniformity and adaptability in terms of language and culture in diverse settings. This is consistent with the overarching goal of leveraging AI to improve language-based tasks' originality and efficiency (Sosoni et al., 2018). Sosoni et al. (2018), for instance, suggested a project to use crowdsourcing to create a multilingual corpus of online instructional content. This research

uses a high-quality crowdsourced corpus with a balanced distribution of themes and languages to translate Massive Open Online Course (MOOC) materials from English into 11 European and BRIC languages (Sosoni et al., 2018). Artificial intelligence (AI) systems are making great strides in bridging language barriers as they become more and more adept at handling difficult linguistic communication tasks, especially the smooth translation of spoken language into text (Gong, 2022). Cross-modal translation could drastically change how we interact and comprehend our environment (Duarte, 2019; Qi & Peng, 2018). To translate spoken and sign language into one another, Duarte (2019) presented a novel neural network architecture for cross-modal sign language translation. The central component of this architecture is a multimodal graph encoder, which creates a comprehensive representation that encapsulates the essence of the input data by smoothly integrating data from spoken language transcripts and sign language movies (Duarte, 2019). A unique cross-modal translation method that translates between several modalities, such as text and visuals, was presented by Qi and Peng (2018). They suggested reinforcement learning as a workable technique for teaching cross-modal translation models to translate text and images accurately in both directions. Their model constantly progresses from more straightforward tasks to more difficult ones as it learns to translate between text and graphics (Qi & Peng, 2018). An era of dynamic and seamless combination of language and visual recognition is being ushered in by AI-driven cross-modal translation.

Future research in AI-driven translation is likely to focus on addressing challenges related to prejudice, cultural sensitivity, and privacy, strengthening human-AI cooperation to exploit the strengths of both human expertise and AI efficiency, and expanding the capabilities of AI translation systems to cope with increasingly complex language tasks and offer more nuanced and contextually suitable translations.

AI Social and Ethical Concerns

Consideration must be given to a broad range of ethical and social issues raised by the increasing incorporation of AI in Translation Studies (TS) (Drugan & Tipton, 2017). The use of AI in TS presents a number of ethical and social implications, including potential job displacement or shifts in translator qualification evaluations, data privacy, and mitigating bias in translation (Albi & Martínez-Carrasco, 2019; Bernardini et al., 2020; Mandarić, 2022; Bo, 2023), despite Drugan and Tipton (2017) arguing that translators should advocate for justice and equity through their work. The translation market is anticipated to be significantly impacted by AI-powered translation. Although artificial intelligence (AI) has novel prospects for the translation industry, the principal fallout from this developing social phenomenon is a change in the qualifications of translators or even the possibility of job displacement (Albi & Martínez-Carrasco, 2019; Bernardini et al., 2020; Mandarić, 2022; Bo, 2023). Massive Open Translation (MOT) is a new translation process that makes use of online platforms and crowdsourcing to enable translation by vast numbers of people, as noted by O'Hagan

(2016). For human translators, this development may have important ramifications (O'Hagan, 2016).

Concerns about the security and privacy of sensitive data are raised by the processing of enormous volumes of linguistic data for AI translation. Large data volumes processed by machine translation (MT) systems can provide security and privacy problems. Protecting user privacy is becoming more and more crucial when AI technologies are included in translation services (Moorkens, 2022). Moreover, cyberattacks may be possible for NMT systems. Malicious actors may use these flaws to influence NMT systems and produce erroneous or deceptive translations (Canfora & Ottmann, 2020). Although translation technology can improve realism and accuracy, it's important to understand its limitations (Vela-Valido, 2021). Certain translation faults might be ignored by AI-powered technology (Vela-Valido, 2021). Although MT systems are capable of producing idiomatic and accurate translations, biases in the training data may be reflected in the translations, raising concerns about the translations' objectivity (Bowker, 2020). Accountability and transparency are crucial when employing AI-based translation systems (Bo, 2023). It's critical to acknowledge that translations are machine-generated and to identify the technology used. Beyond openness, accountability is crucial and necessitates accepting responsibility for any mistakes or problems resulting from translations produced by AI (Bo, 2023).

Discussion:

While the combination of AI in translation services offers the capability to enhance verbal exchange throughout cultures, particularly in fields like business, healthcare, training, and international relations, it also presents enormous demanding situations that warrant cautious attention. The proliferation of computerised translation structures increases worries about the capability erosion of linguistic variety and the loss of unique cultural nuances embedded inside languages. Moreover, the possibility of AI changing human translators raises ethical issues regarding the societal effect of automation and the potential displacement of skilled specialists.

Realising AI's full capability in translation while mitigating its drawbacks requires a sensitive balancing act. Prioritising the upkeep of linguistic variety while concurrently harnessing the benefits of effective communication is critical. Improving translation accuracy for low-resource languages is paramount in selling international inclusion and accessibility.

Future studies should recognise the growing need for extra advanced and correct translation models to handle cultural nuances and context-specific statistics. The improvement of multilingual and multimodal translation models, which are able to process speech, text, and images, represents another essential study course. Such models could no longer best encapsulate the multifaceted nature of conversation but also beautify consumer interaction with diverse multimedia platforms.

Continuous research into the ethical and social implications of AI in translation is crucial. It ensures that the benefits of AI-based translation are maximised while its negative effects are minimised. This ongoing research agenda demonstrates our commitment to developing and responsibly implementing AI technology in the ever-changing translation landscape.

Conclusion:

This review has demonstrated the notable progress made in AI-based Translation Systems (TS) in recent years. Various AI techniques, inclusive of Statistical Machine Translation (SMT), Rule-Based Machine Translation (RBMT), Neural Machine Translation (NMT), and Hybrid Machine Translation (HMT), have been used to enhance translation quality. While each method has its strengths and weaknesses, improvements were remarkable. Evaluation metrics, adequacy, fluency, constancy, and naturalness have effectively assessed the great of AI-based translations. Beyond the technical aspects, this paper explores the broader impact of AI on human lifestyles, encompassing its representation in literature and the humanities. This interdisciplinary lens is known for its enormous capacity for research and innovation, mainly in the burgeoning discipline of digital schooling. The dynamic and evolving nature of AI, evident in its presence in literature and its impact on human society, points toward a destiny in which AI will preserve to form the landscape of the translation era. This evaluation also highlights the complex challenges related to AI in translation. Advanced

models are needed to cope with troubles, deal with literary texts, navigate cultural nuances, and efficiently translate low-aid languages. Additionally, professional and ethical concerns such as ability development, facts privateness, and mitigating bias in AI-based translations require cautious attention. Continuous studies are essential to cope with those demanding situations and ensure that technological advancements align with moral standards and societal duties. Creating a solid and moral AI-based translation environment requires balancing technological advancement and ethical issues.

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