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SYNERGY OF INFORMATION TECHNOLOGIES AND NEURAL NETWORKS FOR TEXT CONTENT GENERATION

The article discusses the potential of neural networks in creating textual content, highlighting their capabilities, limitations, and future directions of use. Neural networks are able to generate adaptive and personalized content that meets the specific requirements and preferences of users. However, the main challenges remain in ensuring the quality, relevance, and originality of automatically generated texts, which is critical for their practical application. Combining information technology with the capabilities of neural networks opens up prospects for improving these processes, but there is still a need for a deeper study of the optimization of such systems. The relevance of the study is due to the possible impact of these solutions on various aspects of public life and the cultural environment.

The paper provides a comparative analysis of the features of using recurrent neural networks, variational autoencoders, generative adversarial networks, and transformers in the creation of textual content, and explores their advantages and limitations in application. Possible difficulties in using generative adversarial networks to create textual and media content (photos, drawings, animations) and the reasons for generating content with unrealistic content are discussed in more detail.

The author proposes criteria for creating a comprehensive assessment of the quality of generated content that can be adapted to specific tasks or requirements. The results of the study include a comprehensive review of the capabilities and limitations of different types of neural networks in creating textual content; examples of their application in various fields such as writing, marketing and business; limitations of using neural networks to create textual content in creative writing. The author emphasizes the need for careful consideration of ethical aspects and the development of recommendations and standards for the use of neural networks to generate a variety of content.

Key words: neural network, text, generation, artificial intelligence, creativity, generative model, content.

Formulation of the problem. The increasing power of computing systems and the development of deep learning algorithms make it possible to use neural networks to create text content, which opens up new opportunities for automating and improving the creative process. Modern technologies for generating text content play an important role in many areas such as journalism, education, e-commerce, and digital marketing. Neural networks can help create personalized and adaptive content that meets the individual needs and preferences of the audience. However, there is a problem of ensuring the high quality, relevance, and uniqueness of automatically generated texts, which is critical for their practical use. The synergy of information technologies and neural networks opens up new opportunities for solving these problems, but the aspects of optimizing such systems to achieve a balance between process automation and quality control of text content are not sufficiently studied. All this determines the relevance of this study, which is determined not only by technical capabilities but also by the potential impact of neural networks on various aspects of modern society and culture.

Researching this issue will help improve automatic text generation technologies, which can have a significant impact on the automation of routine processes in media, education, and business. Solving this problem can also ensure the integration of such solutions into broader technological ecosystems.

Analysis of recent research and publications. Works [2, 10] analyze the results of integrating neural networks with information systems that allow scaling the process of generating textual content in real time. The authors offer a systematic critical review of the general tasks, main approaches and evaluation methods in the field of transformer-based text generation, and provide their criteria for assessing the quality of the generated test, which need to be improved and expanded.

Karthik T. S. notes that text synthesis using neural networks is used in various business areas, in particular to create personalized recommendations, and in the healthcare industry to analyze medical images that help predict the future development of diseases.

As a result, doctors can better detect abnormalities during computed tomography, which improves

patient outcomes [4]. AI helps to generate synthetic data that effectively supports model training data and algorithm development without posing a risk to confidential information.

The author Kundu R. began to consider the various risks of using neural networks for text generation, including the problem of bias in the data used to train models, as well as the risks of losing the uniqueness of author's content [5]. The issue of transparency of algorithms and control over generation results remains important.

Task statement. The main purpose of the article is to investigate the effectiveness of the interaction between information technologies and neural networks for automated text content generation and to determine the optimal approaches to the use of these technologies in real industries such as writing, marketing, and business.

In addition, the paper examines the impact of modern neural network architectures on the quality of text generation, and explores the features of using basic neural network models for text generation. Criteria for a comprehensive assessment of the quality of the generated content are proposed, and prospects for the development of synergy between information technology and neural networks are identified.

Forecasts are given on the trends of the industry development, including increasing the adaptability of texts to the cultural or linguistic context.

Outline of the main material of the study. The use of neural networks in creative industries (scriptwriting, creation of advertising texts) is a promising area that opens up new horizons for authors and literary creators. Neural networks, in particular generative models, have a powerful potential in generating texts that adapt to the styles and genres of different writers and are capable of reproducing unique elements of the style of different authors.

In contemporary creative writing, various types of neural networks are used that are specially adapted for text generation.

One of the most common types is recurrent neural networks or recurrent neural network (RNN). These networks are capable of storing previous information states, which allows them to analyze and generate text sequences taking into account the context [3]. An important area for creating textual content is the use of generative models, such as variational autoencoders (VAEs) and generative adversarial networks (GANs). VAEs allow creating new textual variants while maintaining the ability to latent space, which contributes to the creation of unique and variable texts [7, 8].

Generative adversarial networks, in turn, are capable of adapting to various text generation tasks, including the creation of fiction, short stories, and even technical materials. Their high levels of abstraction and ability to understand the semantics of text make them a powerful tool for creative work, and they are capable of imitating individual styles and expressing authors' emotions.

In recent years, deep neural networks, in particular deep autoencoders and transformers, have been gaining popularity. Transformers have the ability to process sequences in parallel and use attention mechanisms to interact with different parts of the text, which contributes to high-quality generation [1]. Recurrent networks, due to their ability to recurrently use information, can generate sentence sequences taking into account the previous context. An important aspect of neural network architectures in text generation is their ability to learn at different levels of abstraction, which makes their text generation potential very flexible and high quality.

Table 1 provides a comparative analysis of neural networks for creating unique and variable texts.

Table 2 provides an overview of the advantages and limitations of different types of neural networks in the context of their use for text content creation.

“Gradient fading” for recurrent neural networks can affect text generation in the sense that the model may have difficulty learning and reproducing long and complex dependencies in the text. The loss of long-term dependencies between distant parts of the text can lead to a loss of detail and accuracy in text generation [3]. As a result, less comprehensible texts can be created.

To overcome these problems, modifications of recurrent networks such as Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) are often used to manage gradients and retain long-term dependencies more efficiently. Alternative architectures such as transformers can also be used, which have their own mechanisms for processing long text sequences.

The limitations of variational autoencoders are the difficulty of interpreting the latent space, i.e., the abstract space in which important characteristics or features of the data can be represented [9]. The difficulty of interpreting the latent space may arise for the following reasons:

1. One coordinate in latent space can correspond to several independent factors in the original data. Thus, changes in one coordinate can reflect not one, but several different characteristics.

2. The values at each coordinate in the latent space represent probabilities that do not always have a single meaning or interpretation.

Table 1

Features of neural networks for text creation

Features i	Recurrent neural networks (RNN)	Variational autoencoders (VAE)	Generative adversarial networks (GAN)	Transformers
Structure	Ability to “remember” the context	Latent space	Generator and discriminator	Attention mechanism
Participation in the process	Iterative text generation	Ability to vary	Competition between generator and discriminator	Parallel processing of sequences
Context generation	Dependence on previous context	Ability to preserve latent space	Ability to create realistic context	Efficient processing of long texts
Applications	Sequence and text generation	Reconstruction and text generation	Image and text generation, personalization	Text generation, translation, context modeling
Limitations	Computational cost for long sequences	Latent space interpretation	Robustness and learning issues	Computational cost for large text volumes

Table 2

Features of using neural networks to create texts

Neural networks	Advantages	Limitations
Recurrent neural networks	Ability to model sequences; high efficiency in working with texts; use of context to structure the text	Problems with the cost of computing with long sequences; occurrence of “gradient fading” in long sequences
Variational autoencoders	The ability to generate variations; experiments with content diversity; ability to create unique content	Difficulty in interpreting latent space; cost of computing with large amounts of text
Generative adversarial networks	Realistic text appearance due to the competition between the generator and the discriminator; high ability to generate authentic content; variability in image and text generation	Problems with stability and learning; the possibility of creating “surreal” content
Transformers	High efficiency of processing long texts; parallel processing of sequences; efficiency of attention mechanisms for creating context; ability to high-level abstraction and semantics understanding	Cost of computing with large amounts of text

3. Different points in the latent space may correspond to the same representation of the original data, making interpretation difficult. To solve these problems, additional techniques can be used, such as the introduction of latent variables or the use of more complex VAE architectures. GANs can be used to generate both text and other types of content, including media content such as photos, drawings, and animations. Let us consider the difficulties in using generative adversarial networks for content creation.

4. GANs may face the problem of the generator generating different modes during training, which can lead to unstable generation where the network tries to switch between different types of content.

5. The results may be affected by difficulties in achieving a balance between the generator and discriminator models.

6. Similarly to recurrent neural networks, GANs can also face the problem of gradient fading, where gradients become very small or disappear as the error propagates backwards.

The ability to create “surreal” content indicates that GANs can generate images or content that may be fantastic or unrealistic [8]. This can occur for several reasons:

1. If a GAN does not have enough and varied input data, it can generate texts or images that have no analogues in real data, thus creating surreal content.

2. GANs may be able to explore different regions of latent space, which leads to the creation of unpredictable and fantastic content variations.

3. The generator can create content that combines different elements or contexts, which can lead to unexpected and creative results.

The use of transformer neural networks for text generation is complicated by the large number of parameters, which can require significant computing resources, especially when processing large amounts of data. In addition, the process of training such models can take a long time and require optimization of hyperparameters to achieve high quality text generation. An example of a successful use of the transformer architecture is the GPT-4 language

predictive model developed by OpenAI in 2023. The developers claim that the new generation of the neural network is significantly more powerful than GPT 3.5, and the developed multimodal model can work not only with text but also with images [9].

To summarize, neural network architectures not only have powerful text analysis and generation capabilities, but are also constantly evolving. Innovative approaches and combinations of different types of neural networks expand their potential in creating diverse, expressive, and intellectually rich literary works. Neural networks are able to generate texts, adapting them to the context, genre, or style, allowing authors to experiment with new forms of creativity [1]. They not only reproduce syntax, but also convey emotional backgrounds, contributing to the creation of expressive works. Such models act as personalization tools, adapting content to readers' tastes, and as partners in the creative process, offering ideas and new perspectives. However, there are challenges related to the author's identity and originality of texts.

There is an urgent need to develop a methodology for assessing the quality of generated content. Paper [10], for example, proposes to evaluate the quality

of the generated text according to such general criteria as: 1) assessment of how fluent the language of the source text is; 2) assessment of how well the generated text reflects the facts described in the context; 3) assessment of how grammatically correct the generated text is; 4) assessment of the variety of types and styles.

The quality criteria for the produced texts can be based on the following components, shown in Fig. 1.

These criteria can be adapted to meet specific tasks or requirements. Evaluation of automatically generated texts can be done with the help of experts or automated methods.

Let us consider the main difficulties of using neural networks in the creative process:

1. Neural networks can generate ambiguous or unpredictable results, which can complicate the creative process, especially when interpretation or a specific tone is important.

2. The content created may be trivial, devoid of emotion, or not meet the standards of creativity

3. Neural networks can learn and reproduce existing biases or stereotypes, which can lead to the creation of content with an incorrect reflection of reality.

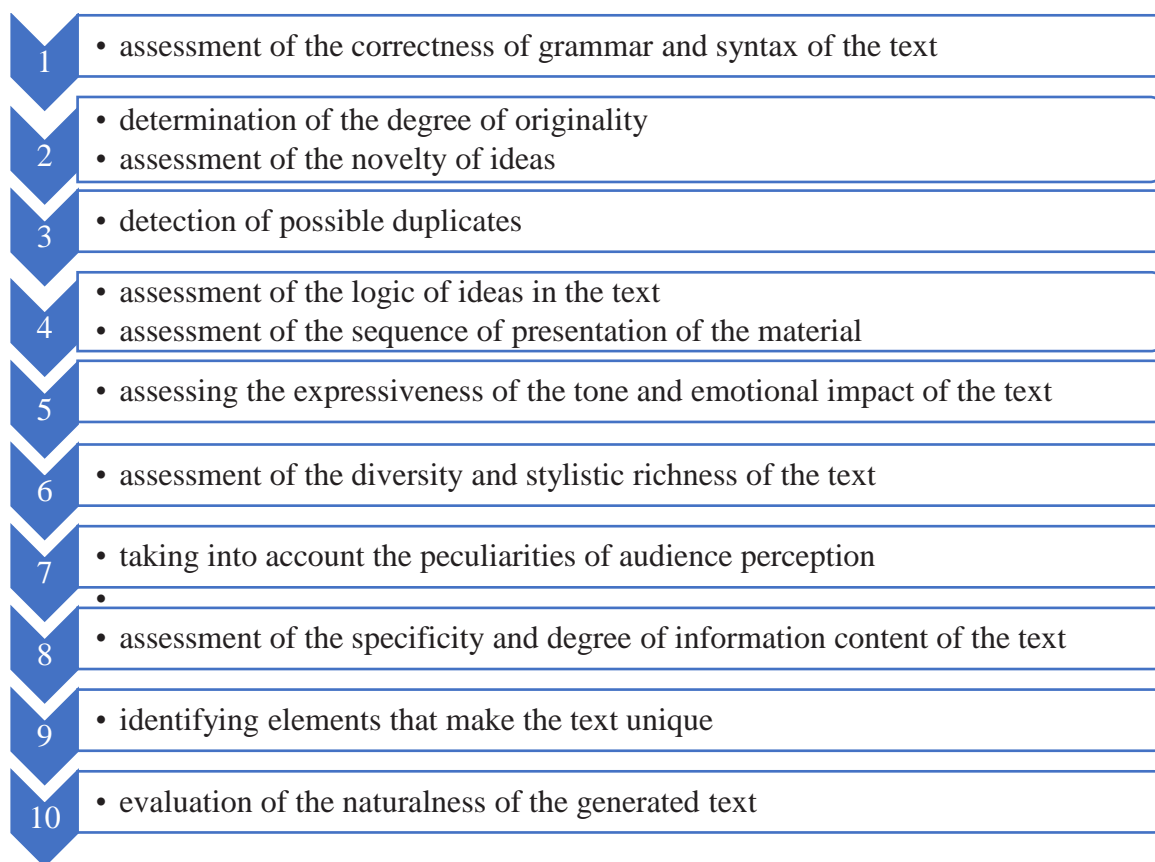


Fig. 1. Structure of a comprehensive assessment of the quality of generated text

4. Language models may have difficulty understanding the broader context, which can affect the quality and understanding of a creative task.

5. The use of powerful neural networks may require significant computational resources and large training data, which may be a limitation for some creative projects.

Conclusions. The use of neural networks in creative writing opens up wide opportunities for experimentation, personalization of texts, and adaptation to different genres and styles. At the same time, this approach requires attention to ethical issues, preservation of the author's individuality, and consideration of the risks of unpredictable results that

may arise during the automated creation of literary works.

A promising area is the development of methods that allow creators to have more control over generation, including the parameters of style, emotion, and other characteristics, with limited training data. Considerable focus should be given to the development of safety standards and ethical guidelines for the use of neural networks in creative fields, in particular to avoid negative consequences or abuse.

Despite the difficulties, the use of neural networks in creative writing is a promising area that could change the paradigm of text creation in the future.

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Бережна О.Б. СИНЕРГІЯ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ І НЕЙРОМЕРЕЖ ДЛЯ ГЕНЕРАЦІЇ ТЕКСТОВОГО КОНТЕНТУ

У статті обговорюється потенціал нейронних мереж у створенні текстового контенту, висвітлюються їхні можливості, обмеження та майбутні напрямки використання. Нейромережі здатні генерувати адаптивний та персоналізований контент, який відповідає специфічним вимогам і перевагам користувачів. Проте основними викликами залишаються забезпечення якості, релевантності й оригінальності автоматично створених текстів, що критично важливо для їх практичного застосування. Поєднання інформаційних технологій із можливостями нейромереж відкриває перспективи для покращення цих процесів, однак залишається необхідність глибшого вивчення питань оптимізації таких систем. Актуальність дослідження обумовлена можливим впливом цих рішень на різні аспекти суспільного життя та культурного середовища.

У роботі надано порівняльний аналіз особливостей використання рекурентних нейромереж, варіаційних автокодерів, генеративних змагальних мереж та трансформерів при створенні текстового контенту, досліджено їх переваги та обмеження у застосуванні. Більш детально розглянуто можливі складнощі у використанні генеративних змагальних мереж для створення текстового та медійного контенту (фотографії, малюнки, анімації) та причини генерації контенту з нереалістичним змістом.

Автор пропонує критерії для створення комплексної оцінки якості згенерованого контенту, які можуть бути адаптовані відповідно до конкретних завдань чи вимог. Результати дослідження включають комплексний огляд можливостей і обмежень нейронних мереж різного типу у створенні текстового контенту; приклади їх застосування в різних сферах, таких як письменництво, маркетинг і бізнес; обмеження використання нейронних мереж для створення текстового контенту у творчому письменництві. Наголошено на необхідності ретельного розгляду етичних аспектів і розробки рекомендацій і стандартів для використання нейромереж для генерації різноманітного контенту.

Ключові слова: нейромережа, текст, генерація, штучний інтелект, творчість, генеративна модель, контент.