

UNLOCKING CHATGPT'S TITLE GENERATION POTENTIAL: AN INVESTIGATION OF SYNONYMS, READABILITY, AND INTRODUCTION-BASED TITLES

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ABSTRACT

The release of ChatGPT, an advanced language model by OpenAI, in November 2022 marked a significant milestone in Natural Language Processing (NLP). ChatGPT demonstrated exceptional capabilities in comprehending and generating human-like language, with applications spanning public health, climate research, education, academia, and more. One of its intriguing features is the generation of titles for various textual content, raising the question of whether ChatGPT can match or surpass human writers in title creation. This study investigates the efficacy of ChatGPT in creating titles for papers across the fields of Computer Science, Chemistry, Physics, and Medicine. The methodology employed examines title generation in scenarios both including and excluding synonyms. This approach aims to evaluate the effectiveness of the generated titles in terms of grammatical correctness, informativeness, conciseness, and engagement. Results reveal that considering synonyms leads to more diverse and contextually rich titles, whereas ignoring them yields titles that closely replicate the original terminology. The choice between these approaches depends on specific use cases. Additionally, variations in title lengths impact readability and SEO optimization, with some titles being shorter, others maintaining similar lengths, and some becoming more detailed. ChatGPT's potential to generate titles based on research paper introductions is also assessed, uncovering the role of synonyms in title variation. This research offers valuable insights into the capabilities and considerations when using ChatGPT for title generation.

Keywords: *ChatGPT, Natural Language Processing, Automated Title Generation, Readability, Engagement*

1. INTRODUCTION

In recent years, the field of Natural Language Processing (NLP) has seen significant growth. However, the release of ChatGPT (Chat Generative Pre-trained Transformer) by OpenAI in November 2022 sparked substantial interest. ChatGPT, a robust language model, demonstrated impressive capabilities in understanding and generating human-like language. Its proficiency in responding to questions, engaging in conversations, and producing coherent and contextually relevant

responses represented a significant advancement in conversational AI. Moreover, it holds promise in various applications, including public health [1] and climate research, covering model parameterization, data analysis, scenario generation, and model evaluation [2]. It also offers the potential in personalized and interactive learning and generating prompts for formative assessments to enhance teaching and learning [3]. Notably, ChatGPT has significant potential to influence academia and libraries, leading to innovative approaches [4]. Furthermore, ChatGPT shows remarkable results as

a writing assistance like finding references and editing language [5], [6]. One of its intriguing capabilities lies in generating research articles [7], raising the fundamental question: Can AI, in the form of ChatGPT, match or surpass human writers and editors in title generation?

A compelling title not only summarizes the content but also piques the reader's interest, influencing their decision to engage with the material. Moreover, when a researcher chooses a title for their article, it must accurately and comprehensively reflect the content of the article. Additionally, the title should express the main ideas of the paper using a moderate number of words. However, there are instances where some titles, while attracting and engaging readers, do not precisely reflect the entire content of the paper.

In this research, we investigate ChatGPT's effectiveness in generating grammatically correct, informative, concise, and engaging titles.

The outcomes of this study have profound implications for those who create content, publish it, and those who consume it. Can AI, specifically ChatGPT, be a reliable collaborator in the effort to craft engaging and informative titles? Or is human involvement still irreplaceable in this creative process? By including Jaccard similarity as one way to measure text similarity, this research aims to uncover the finer details and potential of AI-driven title creation in the modern information landscape.

2. MATERIALS AND METHODS

2.1 Study Design

To assess the precision and efficiency of ChatGPT in producing titles, we employed 13 research papers obtained from IEEE, ScienceDirect, and Web of Science. These articles span various fields, encompassing Computer Science, Chemistry, Physics, and Medicine, ensuring a comprehensive evaluation of ChatGPT's capabilities. Each of which includes original titles along with their corresponding abstracts and introductions.

For evaluating the alignment between ChatGPT-generated titles and the original titles, we utilized a metric, Jaccard Similarity [8].

A new Chatbot was established within ChatGPT, and the AI chatbot was tasked with generating titles for each paper based on the provided abstract, abstract with key keywords, and

introduction. Subsequently, we calculated the Jaccard similarity score twice, once while ignoring synonym words and once while considering them.

2.2 Methodology

Prompts

To generate titles, we used the following input prompts:

Construct a descriptive title for a research paper based on the following introduction...

Construct a descriptive title for a research paper based on the following abstract....

Construct a descriptive title for a research paper based on the following abstract and list of keywords

Similarity computation

The titles created were subsequently examined to measure their similarity to the original titles. We employed a text similarity metric called Jaccard similarity, which evaluates the overlap between the sets of words in the titles.

Jaccard similarity, also referred to as the Jaccard coefficient or Jaccard index, is a measure of similarity between two sets. It finds applications in diverse fields such as data analysis, text mining, and information retrieval. This metric quantifies similarity by assessing the proportion of shared elements in two sets relative to their combined size. The Jaccard similarity (J) is defined as:

$$J(A, B) = \frac{|A \cap B|}{|A \cup B|} \quad (1)$$

Where A is the first set and B is the second set, $|A \cap B|$ represents the size (number of elements) of the intersection of sets A and B and $|A \cup B|$ represents the size of the union of sets A and B .

Jaccard similarity scores fall between 0 and 1. The closer the score is to 1, the more similar the sets are, while as the score approaches 0, the sets exhibit decreasing levels of similarity. As an illustration, the following example shows the process of calculation of similarity between the original title “Evolving Deep Multiple Kernel Learning

Networks Genetic Algorithms” and the generated one **“Enhancing Trustworthiness Efficiency IIoT Evolving Deep Multiple Kernel Learning Network Genetic Algorithm”**.

Case1: Ignoring synonym words.

Intersection: {Evolving, Deep, Multiple, Kernel, Learning, Genetic, Algorithm}

Union: {Enhancing, Trustworthiness, Efficiency, IIoT, Evolving, Deep, Multiple, Kernel, Learning, Genetic, Algorithm, Networks, Genetic, Algorithms}

Jaccard Similarity = (Size of Intersection) / (Size of Union) = 7 / 13 ≈ 0.5385

Case2: Considering synonym words.

"Enhancing" and "Evolving" can be considered synonyms in this context.

"Trustworthiness" and "Reliability" can be considered synonyms.

"Efficiency" and "Performance" can be considered synonyms.

"Network" and "Networks" are already similar.

"Genetic Algorithm" and "Genetic Algorithms" are similar.

Calculate the Jaccard similarity:

Intersection (including synonyms): {Evolving, Deep, Multiple, Kernel, Learning, Network/Networks, Genetic Algorithm/Algorithms}

Union: {Evolving, Deep, Multiple, Kernel, Learning, Network/ Networks, Genetic Algorithm/ Algorithms, Trustworthiness/ Reliability, Efficiency/ Performance}

Jaccard Similarity = (Size of Intersection) / (Size of Union) = 7 / 10 = 0.7

This method of calculation is utilized for 17 articles, as presented in both Table 1 and Table 2,

displaying titles generated from the abstract and introduction, respectively.

3. RESULTS AND DISCUSSION

In this section, we delve into the effectiveness of generating titles by providing ChatGPT with abstracts and introductions. We highlight the impact of considering or ignoring synonyms in title generation and discuss the resultant differences in similarity scores.

3.1 Efficacy of Generating Titles Based on Abstract

In our examination of ChatGPT's capability to generate titles from abstracts, we discovered a significant distinction in the way titles are produced when considering synonyms versus when ignoring them. When synonyms are considered, ChatGPT produces titles that encompass a broader range of semantically similar terms, resulting in more diverse and contextually rich titles. On average, the similarity scores for titles generated while considering synonyms range from 0.301 to 0.840, with an average of around 0.515 across the 13 examples. This approach, which yields higher average similarity scores, showcases ChatGPT's ability to incorporate synonyms effectively and capture the essence of the original content. However, when synonyms are ignored, ChatGPT tends to generate titles that closely adhere to the exact terminology found in the original content. The average similarity scores for titles generated without considering synonyms range from 0.25 to 0.769, averaging approximately 0.492. Ignoring synonyms may lead to slightly lower average similarity scores, but it results in titles that faithfully replicate the precise wording of the original content.

The choice between considering or ignoring synonyms depends on the specific use case and desired outcomes. Ignoring synonyms is preferable when the goal is to maintain linguistic fidelity to the original titles and content. It results in a relatively higher average similarity score. However, considering synonyms can be advantageous when the aim is to produce engaging, informative, or audience-tailored titles.

The length of generated titles compared to the original titles is another essential aspect to consider. Title length can significantly impact readability, search engine optimization (SEO), and overall effectiveness in conveying the essence of the content. The generated titles exhibit varying lengths

Table 1. Generated Titles by Given Abstract

Original Title	Generated Title abstract-based	Similarity score/ ignore synonyms	Similarity score/ consider synonyms	Generated titles abstract and keywords-based	Similarity score/ ignore synonyms	Similarity score/ consider synonyms
Evolving Deep Multiple Kernel Learning Networks Through Genetic Algorithms [9]	"Enhancing Trustworthiness and Efficiency in IIoT with an Evolving Deep Multiple Kernel Learning Network via Genetic Algorithm"	0.538	0.7	Enhancing Trustworthy Industrial IoT through Evolving Deep Multiple Kernel Learning Network with Genetic Algorithm for Efficient AutoML	0.2857	0.3
Enhancing Trustworthy Deep Learning for Image Classification against Evasion Attacks: A systematic literature review [10]	A Comprehensive Review of Adversarial Machine Learning Techniques for Enhancing the Robustness of Deep Learning Models in Image Classification	0.291	0.64	Evaluating Adversarial Machine Learning Techniques for Trustworthy Image Classification in Deep Learning: A Comprehensive Review and Framework Development	0.714	0.714
Fairness Testing of Machine Learning Models Using Deep Reinforcement Learning [11]	"Enhancing Fairness Testing in Machine Learning Models: An Adaptive Approach Using Deep Reinforcement Learning for Identifying Individual Discriminatory Inputs"	0.478	0.782	Advancing Fairness Testing for Machine Learning Models: An Adaptive Approach Using Deep Reinforcement Learning and Efficient Test Data Generation	0.421	0.761
Hybrid Filter-Wrapper Text Feature Selection Technique for Text Classification [12]	" Enhancing Text Classification Through Feature Selection: A Combined Information Gain and Gray Wolf Optimizer Approach "	0.16	0.25	Enhancing Text Classification with Hybrid Feature Selection: Information Gain-Guided Binary Gray Wolf Optimizer	0.31	0.312
Remaining Useful Life Prediction with Partial Sensor Malfunctions Using Deep Adversarial Networks [13]	Robust Remaining Useful Life Prediction for Machinery Health Assessment in Real Industrial Environments: A Deep Learning Approach with Sensor Fault Tolerance	0.36.	0.642	Robust Remaining Useful Life Prediction in Industrial Machinery: A Deep Learning Approach for Sensor Fault Tolerance and Enhanced Feature Integration	0.482	0.607

A Review on Generative Adversarial Networks: Algorithms, Theory, and Applications [14]	A Comprehensive Review of Generative Adversarial Networks (GANs): Algorithms, Theory, and Applications	0.769	0.866	A Comprehensive Review of Generative Adversarial Networks: Unifying Algorithms, Theoretical Foundations, and Multidisciplinary Applications	0.588	0.833
Image Segmentation Using Deep Learning: A Survey [15]	Advances in Deep Learning-Based Image Segmentation: A Comprehensive Review of Models and Applications	0.312	0.684	Deep Learning-Based Image Segmentation: A Comprehensive Review of Models, Architectures, and Performance in Computer Vision	0.238	0.57
A druggable copper-signalling pathway that drives inflammation [16]	Copper-Mediated Metabolic Reprogramming: A Therapeutic Strategy for Inflammation and Cell Plasticity	0.2	0.571	Copper-Mediated Metabolic Reprogramming via CD44: A Therapeutic Approach to Modulate Inflammation and Cell Plasticity	0.09	0.25
Aerosol liquid water in PM 2.5 and its roles in secondary aerosol formation at a regional site of Yangtze River Delta [17]	Seasonal Variations in Aerosol Liquid Water Content (ALWC) and Its Impacts on Secondary Aerosol Formation and Air Quality in Shanxi, China	0.343	0.344	Aerosol Liquid Water Content and Its Impact on Secondary Aerosol Formation and Air Quality: Insights from a Year-Long Field Campaign in North Zhejiang Province	0.363	0.386
Towards high-entropy alloys with high-temperature corrosion resistance and structural stability [18]	Tailoring Eutectic High-Entropy Alloys for High-Temperature Applications: Thermodynamic Route, Performance Assessment, and Physicochemical Insights	0.375	0.321	Tailoring High-Entropy Alloys for Superior High-Temperature Performance: Thermodynamic Exploration of Eutectic High-Entropy Alloys and Their Hot Corrosion Resistance	0.227	0.227
Bias in Laboratory Medicine: The Dark Side of the Moon [19]	Mitigating Bias in Laboratory-Derived Medical Information: A Comprehensive Review of Metrological and Statistical Principles for Enhanced Patient Safety and Diagnostic accuracy	0.103	1.0	Mitigating Bias in Laboratory Testing for Enhanced Patient Care: A Comprehensive Review of Metrological and Clinical Perspectives	0.130	0.130
A review on mercury in natural gas and its condensate: Accurate characterization and efficient control technologies for total and speciated mercury [20]	Comprehensive Review of Mercury Removal from Natural Gas and Condensate: Species, Analysis, Adsorbents, and Future Challenges	0.454	0.769	Mercury Characterization and Removal in Natural Gas and Condensate: A Comprehensive Review of Speciation, Analysis, and Adsorbent Selection	0.59	0.809

Anti-vascular endothelial growth factor drugs combined with laser photocoagulation maintain retinal ganglion cell integrity in patients with diabetic macular edema: study protocol for a prospective, non-randomized, controlled clinical trial [21]	Enhancing Visual Recovery in Diabetic Macular Edema: Combining Anti-VEGF Drugs and Laser Photocoagulation for Retinal Ganglion Cell Integrity	0.466	0.948	Enhancing Vision Recovery in Diabetic Macular Edema: A Clinical Trial Investigating the Synergy of Anti-Vascular Endothelial Growth Factor Drugs and Laser Photocoagulation on Retinal Ganglion Cell Integrity	0.73	0.904
A blockchain-enabled privacy-preserving authentication management protocol for Internet of Medical Things [22]	Blockchain-Based Privacy-Preserving Authentication Management for Secure Internet of Medical Things (IoMT) Services"	0.642	0.66	Blockchain-Based Three-Factor Privacy-Preserving Authentication Protocol for Securing the Internet of Medical Things	0.45	0.454
Fantastic voyage: The journey of NLRP3 inflammasome activation [23]	Unveiling the Dynamics of NLRP3 Inflammasome Activation: Insights into Subcellular Localization and Regulatory Mechanisms	0.375	0.684	Deciphering the Molecular Mechanism of NLRP3 Inflammasome Activation: Insights into Subcellular Localization and Regulatory Pathways in Innate Immunity	0.3	0.818
Fuzzy Rough Set based Feature Selection and Enhanced KNN Classifier for Intrusion Detection [24]	Efficient Intrusion Detection System Enhancement through Maximum Dependence Maximum Significance Feature Selection and K-Nearest Neighborhood Classification	0.228	0.277	Enhancing Intrusion Detection System Performance with Maximum Dependence Maximum Significance Feature Selection and K-Nearest Neighborhood Classification	0.312	0.50
Analytic study for the parallel processing algorithms [25]	Exploring Parallel Processing Technology: Types, Algorithms, and Application of Publication Algorithms for Efficient Memory Access	0.235	0.29	Exploring Parallel Processing Algorithms in Information Technology for Enhanced Computational Efficiency	0.307	0.454

Table 2. Generated Titles by Given Introduction

Original Title	Generated Title introduction-based	Similarity score/ ignore synonyms	Similarity score/ consider synonyms
Evolving Deep Multiple Kernel Learning Networks Through Genetic Algorithms [9]	Enhancing Trustworthiness and Automation in Industrial IoT with Genetic Algorithm-Based Kernel Learning Network (KNGA)	0.33	0.818
Enhancing Trustworthy Deep Learning for Image Classification against Evasion Attacks: A systematic literature review [10]	Enhancing Trustworthiness and Robustness of Deep Learning Models: A Holistic Approach to Adversarial Machine Learning with the TPre-ADL Framework	0.26	0.50
Fairness Testing of Machine Learning Models Using Deep Reinforcement Learning [11]	Reinforcement Learning for Efficient Black-Box Fairness Testing in Machine Learning Models	0.461	0.461

Hybrid Filter-Wrapper Text Feature Selection Technique for Text Classification [12]	Optimizing Text Classification Through Hybrid Feature Selection and Meta-Heuristic Algorithms	0.384	0.391
Remaining Useful Life Prediction with Partial Sensor Malfunctions Using Deep Adversarial Networks [13]	Enhancing Machinery Prognostics and Health Management (PHM) Using Deep Learning: Robust RUL Prediction in the Presence of Sensor Malfunctions	0.148	0.259
A Review on Generative Adversarial Networks: Algorithms, Theory, and Applications [14]	Comprehensive Survey of Generative Adversarial Networks (GANs): Algorithm, Theory, and Applications Across Diverse Domains	0.411	0.60
Image Segmentation Using Deep Learning: A Survey [15]	Deep Learning-Based Image Segmentation: A Comprehensive Survey and Performance Analysis across Various Architectures and Applications	0.375	0.722
A druggable copper-signalling pathway that drives inflammation [16]	Modulating Inflammation and Cell Plasticity: Targeting Mitochondrial Copper(II) through CD44 Inhibition for Therapeutic Innovation	0.136	0.136
Aerosol liquid water in PM 2.5 and its roles in secondary aerosol formation at a regional site of Yangtze River Delta [17]	Role of Aerosol Liquid Water Content (ALWC) in Secondary Aerosol Formation and Air Quality in North Zhejiang Province	0.24	0.937
Towards high-entropy alloys with high-temperature corrosion resistance and structural stability [18]	Eutectic High-Entropy Alloys (EHEAs) for Hot Corrosion Resistance in Gas Turbine Engine Components: A Thermodynamic and Experimental Approach	0.26	0.41
Bias in Laboratory Medicine: The Dark Side of the Moon [19]	Comprehensive Evaluation of Bias in Laboratory Test Results: Metrological, Clinical, and Practical Perspectives	0.40	0.46
A review on mercury in natural gas and its condensate: Accurate characterization and efficient control technologies for total and speciated mercury [20]	Mercury Characterization and Management in Natural Gas and Condensate	0.50	0.65
Anti-vascular endothelial growth factor drugs combined with laser photocoagulation maintain retinal ganglion cell integrity in patients with diabetic macular edema: study protocol for a prospective, non-randomized, controlled clinical trial [21]	Evaluating Retinal Ganglion Cell Integrity in Diabetic Macular Edema Patients Undergoing Combined Anti-VEGF and Laser Treatment: Implications for Visual Recovery	0.53	0.69
A blockchain-enabled privacy-preserving authentication management protocol for Internet of Medical Things [22]	Enhancing Security and Privacy in Internet of Medical Things (IoMT) through Blockchain-Based Three-Factor Authentication	0.76	0.72
Fantastic voyage: The journey of NLRP3 inflammasome activation [23]	NLRP3 Inflammasome Activation: The Role of Dynamic Subcellular Localization in Inflammatory Responses	0.24	0.357
Fuzzy Rough Set based Feature Selection and Enhanced KNN Classifier for Intrusion Detection [24]	Enhancing Intrusion Detection and Security with Feature Selection and Novel Classification Algorithms Using KDD Dataset	0.238	0.285
Analytic study for the parallel processing algorithms [25]	Revolutionizing Computer Processing: Exploring Effective Parallel Programming Algorithms for Multiprocessor Systems and Large Networks	0.235	0.285

in comparison to the original titles. some are notably shorter, ensuring brevity and clarity. others have similar lengths, maintaining the original titles' succinctness. in some instances, the generated titles are longer, offering more context and detail. While this can be advantageous for conveying the scope of the work, it may require attention to readability and SEO optimization.

3.2 Efficacy of Generating Titles Based on Introduction

When generating titles based on research paper introductions, without considering synonyms, the average Jaccard similarity score is approximately 0.314, indicating that generated titles overlap by around 31.4 % with the original titles. This suggests room for improvement in aligning generated titles more closely with the originals. The inclusion of synonyms increases the average score to approximately 47.8 %, offering greater flexibility and variability in generated titles.

However, the variation in similarity scores among different cases suggests that ChatGPT's title generation may vary in how closely it aligns with the original title. factors such as introduction complexity and domain-specific terms influence this variation. generated titles also exhibit varying lengths, with some being more concise and others more detailed. longer titles can provide additional context but risk becoming overly verbose. ChatGPT demonstrates an aptitude for including relevant technical terms and keywords, contributing to a clear representation of the research focus in the generated titles.

The decision to include synonyms, consider title length, and ensure alignment with the original titles should be guided by specific requirements, objectives, and the target audience. These observations provide crucial insights into the capabilities and factors to consider when employing ChatGPT for generating titles. Despite the demonstrable results shown by ChatGPT, the role of human evaluation remains crucial in assessing the generated titles across different fields.

4. CONCLUSION

The extensive potential of ChatGPT across various applications prompts the inquiry of whether AI can rival human writers and editors in crafting article paper titles. this study delved into ChatGPT's performance in title generation based on abstracts and introductions, revealing that considering synonyms leads to more contextually

rich titles while omitting them results in titles closely mirroring the original terminology. additionally, title length emerges as a critical aspect impacting readability and SEO. It's noteworthy that ChatGPT's adeptness in incorporating technical terms and keywords enhances the clarity of the generated titles. decisions regarding synonym usage, title length, and alignment with original titles should be tailored to the unique requirements of each research paper. in conclusion, ChatGPT's title generation strikes a balance between fidelity to original titles and the flexibility to employ synonyms and alternative phrasing. while it may not consistently replicate original titles, it excels in encapsulating the core themes of research with a reasonable degree of flexibility. Researchers and authors should consider ChatGPT-generated titles as a starting point, refining them for clarity, brevity, and relevance.

The decision to include synonyms, consider title length, and ensure alignment with the original titles should be guided by specific requirements, objectives, and the target audience. These observations provide crucial insights into the capabilities and factors to consider when employing ChatGPT for generating titles. Despite the demonstrable results shown by ChatGPT, the tool cannot be used as a standalone generator for titles, given its limitations in fully grasping the main ideas and core objectives of the content based solely on the abstract and introduction. A real assessment by specialists in the field remains essential. Moreover, this study could be extended in the future to assess how well the generated titles engage with the entire content, as evaluated by experts across various fields.

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