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Article

Building an Interactive NLP Tool for Assisting Human Poets in Real-Time Composition

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Abstract

This paper explores the creation of an interactive Natural Language Processing (NLP) tool aimed at assisting human poets in real-time composition. Poetry, as a unique form of artistic expression, intertwines linguistic creativity with emotional depth, making the integration of technology a compelling avenue for enhancing the creative writing process. The primary objective of this project is to develop an intuitive and responsive tool that supports poets in generating ideas, refining language, and experimenting with poetic structures. The tool employs state-of-the-art NLP algorithms, including deep learning models trained on diverse corpora of poetry, to analyze input text and provide contextualized feedback. Key functionalities include thematic suggestion generation, stylistic analysis, and structural recommendations, allowing poets to explore various poetic forms and devices dynamically. By facilitating a dialogue between the user and the tool, we aim to foster a collaborative creative environment that encourages experimentation and innovation. To assess the tool's impact on the creative process, we conducted a series of iterative design phases coupled with user testing involving both novice and experienced poets. Participants engaged with the tool in various poetic tasks, providing qualitative and quantitative data on their experiences. Initial findings suggest that users reported heightened engagement and inspiration, with many expressing that the tool helped them overcome creative blocks. Furthermore, the feedback mechanisms embedded within the tool enabled poets to gain insights into their writing, promoting a deeper understanding of poetic techniques and enhancing their overall skill. This research contributes to the burgeoning field of computational creativity and underscores the potential of technology to augment artistic practices. By examining the intersection of NLP and the arts, we not only highlight the innovative capabilities of our tool but also propose directions for future research in digital humanities. As we move forward, we envision expanding the tool's functionalities to include collaborative features, multilingual support, and integration with other artistic mediums, thus broadening its applicability in creative contexts. Ultimately, this project aims to redefine the role of technology in poetry, transforming it from a mere tool into a true partner in the creative journey.

Keywords: interactive NLP tool; poetry; real-time composition; natural language processing; user-centered design; machine learning

Chapter 1: Introduction

1.1. Background

The art of poetry has long been a medium through which human emotions, thoughts, and cultural narratives are expressed. Throughout history, poets have utilized language not merely as a vehicle for communication but as a canvas for creativity, crafting works that resonate with the human experience. In recent years, the advent of technology, particularly in the realms of artificial intelligence (AI) and natural language processing (NLP), has opened new avenues for artistic expression, prompting a reevaluation of how poets engage with their craft.

The proliferation of digital tools has altered the landscape of creative writing, enabling poets to explore innovative approaches to composition. However, while numerous applications exist to assist writers, few specifically cater to the unique demands of poetry. This chapter sets the stage for understanding the necessity of an interactive NLP tool designed to enhance the poetic process, addressing both the challenges and opportunities presented by the intersection of technology and art.

1.2. *The Role of Technology in Creative Writing*

The relationship between technology and creative writing has evolved significantly over the past few decades. Early word processors revolutionized the way writers drafted and edited their works, streamlining the writing process. The emergence of AI-driven tools has further transformed this landscape, providing writers with resources such as grammar checking, style analysis, and even content generation. These tools have primarily focused on prose, leaving a substantial gap in support for poets.

Poetry is characterized by its nuanced use of language, rhythm, and structure. Unlike prose, which often prioritizes clarity and narrative flow, poetry embraces ambiguity, metaphor, and emotional resonance. As a result, the needs of poets are distinct and require specialized tools that can understand and analyze the subtleties of poetic language. This chapter argues for the development of an interactive NLP tool specifically designed to assist poets in real-time, thereby enriching their creative process.

1.3. *Challenges Faced by Poets*

Despite the availability of writing aids, poets frequently encounter several challenges that can hinder their creative flow. These challenges include:

1. **Creative Blocks:** Many poets experience periods of stagnation, where inspiration seems elusive. A supportive tool that offers thematic prompts or stylistic suggestions could help mitigate these blocks.
2. **Understanding Poetic Devices:** Poets often experiment with various forms and devices, such as meter, rhyme, and imagery. A tool that provides real-time feedback on these elements could enhance a poet's understanding and application of such techniques.
3. **Language Nuance:** The subtleties of language—tone, connotation, and rhythm—are crucial in poetry. Traditional writing aids may not adequately capture these nuances, leading to a disconnect between the poet's intent and the tool's suggestions.
4. **Collaboration and Feedback:** Many poets work in isolation, which can limit their exposure to diverse perspectives. A collaborative tool could facilitate interaction with peers, enriching the creative process through shared insights.

1.4. *Objectives of the Study*

The primary objective of this study is to develop an interactive NLP tool that addresses the unique needs of poets, enabling real-time assistance in composition. This tool aims to:

- Provide thematic and stylistic suggestions that align with the poet's creative intent.
- Facilitate a deeper understanding of poetic structures and devices through analytical feedback.
- Foster a collaborative environment where poets can engage with one another and share their work.
- Enhance the overall creative experience by reducing barriers to poetic expression.

1.5. *Research Questions*

To guide the development and evaluation of the NLP tool, this study will address the following research questions:

1. How can NLP algorithms effectively analyze and understand the nuances of poetic language?
2. What features are most beneficial to poets during the composition process?
3. How does real-time feedback from the tool influence a poet's creativity and understanding of their craft?
4. In what ways does the tool facilitate collaboration among poets?

1.6. Significance of the Study

This research contributes to the fields of computational creativity and digital humanities by exploring the intersection of technology and poetic expression. By focusing on the development of a dedicated NLP tool for poets, this study not only aims to enhance the creative process but also seeks to redefine the role technology plays in artistic endeavors. Furthermore, the findings could inform future innovations in digital tools for creative writing, potentially inspiring new methodologies for integrating AI into the arts.

1.7. Structure of the Thesis

The subsequent chapters of this thesis will provide a comprehensive overview of the project's development. Chapter 2 will review relevant literature in NLP, poetry, and creative writing tools, establishing a theoretical framework for the study. Chapter 3 will detail the methodology employed in designing and testing the interactive tool. Chapter 4 will present the results of user testing, highlighting the tool's effectiveness in enhancing the poetic process. Finally, Chapter 5 will discuss the implications of the findings and propose directions for future research.

1.8. Conclusion

In conclusion, this chapter has outlined the context and significance of developing an interactive NLP tool to assist poets in real-time composition. By addressing the unique challenges faced by poets and emphasizing the potential benefits of technology in the creative process, this study aims to contribute meaningfully to the ongoing dialogue about the role of AI in the arts. The following chapters will delve deeper into the theoretical and practical aspects of this endeavor, ultimately paving the way for a transformative approach to poetic expression.

Chapter 2: Literature Review

2.1. Introduction

This chapter reviews the existing literature on the intersection of Natural Language Processing (NLP) and creative writing, particularly focusing on poetry. It aims to contextualize the development of an interactive NLP tool for assisting poets by examining previous research, technological advancements, and the theoretical frameworks that inform this project. The review is organized into several key areas: the evolution of NLP technologies, the application of these technologies in creative writing, the role of AI in artistic expression, and the implications of collaboration between humans and machines in the creative process.

2.2. The Evolution of Natural Language Processing

Natural Language Processing has evolved significantly over the past few decades. Early approaches primarily relied on rule-based systems and symbolic processing, which limited their effectiveness in understanding and generating human language. However, the advent of statistical methods in the 1990s marked a paradigm shift, with machine learning techniques allowing for more sophisticated language models. Recent advancements have seen the rise of deep learning, particularly through the development of recurrent neural networks (RNNs) and transformer models, which have greatly improved the ability to process and generate natural language.

2.2.1. Key Technological Milestones

Several milestones have been pivotal in the evolution of NLP:

- **Statistical Language Models:** Techniques such as n-grams laid the groundwork for understanding language patterns statistically.
- **Word Embeddings:** The introduction of word embeddings like Word2Vec and GloVe enabled models to capture semantic relationships between words, paving the way for deeper language understanding.
- **Transformer Models:** The release of the Transformer architecture in 2017 revolutionized NLP, allowing for parallel processing and better handling of context, leading to models like BERT and GPT.

These technological advancements form the backbone of the NLP tool developed in this project, enabling more nuanced interactions with poetic language.

2.3. NLP in Creative Writing

The application of NLP in creative writing has garnered increasing interest in recent years. Various studies have explored how NLP can enhance the creative process, offering tools for generating text, analyzing style, and providing feedback.

2.3.1. Generative Models

Generative models, particularly those based on deep learning, have been employed to create poetry and prose. Research has shown that model-generated text can exhibit stylistic and thematic coherence, prompting discussions about the nature of creativity and authorship. For instance, projects like OpenAI's GPT-3 have demonstrated the capability to produce human-like text across various genres, including poetry.

2.3.2. Analysis and Feedback Tools

In addition to generation, NLP tools have also been developed to assist writers in analyzing their work. Tools that provide stylistic feedback, suggest synonyms, and analyze meter and rhyme schemes have shown promise in fostering writers' growth. These functionalities are critical for the proposed tool, as they aim to enhance poets' understanding of their craft while encouraging experimentation.

2.4. AI and Artistic Expression

The relationship between artificial intelligence and artistic expression is a complex and evolving discourse. Scholars have debated the implications of using AI in creative fields, raising questions about originality, creativity, and the role of the artist.

2.4.1. The Nature of Creativity

The philosophical inquiry into creativity often hinges on the definition of what it means to create. Some argue that true creativity requires consciousness and intent, while others posit that AI-generated works can be considered creative if they elicit emotional responses. This project acknowledges these debates while focusing on the tool's function as a collaborator, emphasizing the role of the poet in shaping the final output.

2.4.2. Human-Machine Collaboration

The collaborative potential of human-machine interactions is an exciting area of exploration. Research has shown that when artists engage with AI tools, they often experience a shift in their creative process, leading to new forms of expression. This chapter advocates for a model of

collaboration where poets leverage the tool's capabilities to enhance their creativity without diminishing their artistic voice.

2.5. *Practical Applications and Case Studies*

Several case studies illustrate the practical applications of NLP tools in creative writing. For example, initiatives like "Bot or Not" engage participants in identifying whether a poem was written by a human or generated by a machine. Such projects highlight the capabilities of NLP while stimulating dialogue about authorship and authenticity.

2.6. *Implications for the Current Study*

The insights gleaned from the literature underscore the need for an interactive NLP tool that not only generates text but also fosters a collaborative environment for poets. By synthesizing advancements in NLP with the dynamics of creative writing, this project aims to contribute to the ongoing discourse on the role of technology in the arts.

2.7. *Conclusion*

This chapter has reviewed the foundational concepts and relevant literature surrounding NLP, creative writing, and the intersection of AI and artistic expression. By situating the current project within this broader context, it becomes clear that the development of an interactive NLP tool for poets is not only timely but also essential for exploring new horizons in creative expression. The subsequent chapters will delve into the methodology, design, and user testing of the tool, further elucidating its potential impact on the poetic landscape.

Chapter 3: Methodology

3.1. *Introduction*

This chapter outlines the methodological framework employed to develop the interactive Natural Language Processing (NLP) tool designed to assist human poets in real-time composition. The approach integrates principles from computational linguistics, user-centered design, and qualitative research methods to ensure that the tool is both effective and engaging for its users. The chapter is divided into several sections: the design and development process, the algorithms and technologies utilized, user testing protocols, and data analysis methods.

3.2. *Design and Development Process*

The development of the NLP tool followed an iterative design process, which is characterized by cycles of prototyping, testing, and refinement. This approach allowed for continuous user feedback and adaptation, ensuring that the tool met the needs of poets.

3.2.1. *Initial Conceptualization*

The project commenced with a thorough literature review on existing NLP applications in creative writing and poetry. This phase identified gaps in current technologies, particularly the lack of tools that provide real-time assistance while respecting the artistic integrity of the poet's voice. Based on this review, we defined the core functionalities of the tool, including:

- **Thematic suggestion generation:** Offering users relevant themes based on their input.
- **Structural analysis:** Evaluating the poem's form and providing recommendations for enhancement.
- **Stylistic feedback:** Analyzing the language and suggesting alternative word choices or stylistic devices.

3.2.2. Prototyping

Following the initial conceptualization, we developed a minimum viable product (MVP) that incorporated basic versions of the desired features. This prototype was designed for desktop use, leveraging a simple user interface that allowed poets to input text and receive real-time feedback. The interface included:

- A text input area for poem composition.
- A sidebar displaying suggestions and analyses.
- An interactive component where users could click on suggestions for integration into their work.

3.2.3. Iterative Testing

The MVP was subjected to iterative testing with a diverse group of poets. Each testing session involved observing users as they interacted with the tool, followed by structured interviews to gather feedback. Key aspects evaluated during testing included ease of use, the relevance of suggestions, and overall user satisfaction.

3.3. Algorithms and Technologies

The backbone of the NLP tool consists of several advanced algorithms and technologies that facilitate its core functionalities.

3.3.1. Natural Language Processing Techniques

We employed a combination of rule-based and machine learning approaches to analyze and generate poetic content. The key components included:

- **Tokenization and Parsing:** Breaking down user input into manageable units for analysis.
- **Sentiment Analysis:** Evaluating the emotional tone of the text to provide thematic suggestions.
- **Language Modeling:** Utilizing deep learning models, such as Transformer architectures, trained on a corpus of poetry to generate contextually appropriate suggestions.

3.3.2. Implementation

The tool was developed using Python and integrated with several libraries, including NLTK for natural language processing and TensorFlow for machine learning. The user interface was built with React, ensuring a responsive design that adapts to various screen sizes.

3.3.3. Data Sources

To train the underlying models, we curated a diverse dataset comprising classic and contemporary poetry from various genres and cultural backgrounds. This dataset was augmented with user-generated content during the testing phases, allowing the model to learn from real-world poetic styles and preferences.

3.4. User Testing Protocols

User testing was conducted in multiple phases, focusing on both qualitative and quantitative data collection.

3.4.1. Participant Selection

Participants were selected based on their experience levels with poetry. We aimed for a balanced group that included novice poets, experienced writers, and educators in the field of creative writing. This diversity ensured a comprehensive understanding of the tool's usability across different skill levels.

3.4.2. Testing Sessions

Each testing session consisted of the following components:

1. **Introduction:** Participants were briefed on the tool's functionalities and objectives.
2. **Task Completion:** Users were asked to compose a poem using the tool while thinking aloud, providing insights into their thought processes.
3. **Feedback Collection:** After task completion, participants engaged in semi-structured interviews to discuss their experiences, focusing on aspects such as usability, engagement, and the perceived value of suggestions.

3.4.3. Data Analysis

Qualitative data from interviews were transcribed and analyzed using thematic analysis to identify common patterns and insights. Quantitative data, such as user satisfaction ratings, were statistically analyzed to evaluate the tool's overall effectiveness.

3.5. Ethical Considerations

Throughout the research process, ethical considerations were paramount. We ensured that all participants provided informed consent and understood their right to withdraw at any stage. Additionally, we anonymized user data to protect their privacy and confidentiality.

3.6. Conclusion

This chapter provided a comprehensive overview of the methodology employed in developing the interactive NLP tool for assisting poets. By integrating user-centered design principles with advanced NLP techniques, we aimed to create a tool that not only enhances the creative process but also respects the artistic voice of the poet. The next chapter will present the results of the user testing and discuss the implications of our findings for the field of computational creativity.

Chapter 4: Methodology and Tool Development

4.1. Introduction

The objective of this chapter is to detail the methodology employed in the development of the interactive Natural Language Processing (NLP) tool designed for real-time assistance in poetic composition. This chapter is structured into several subsections: the overall design framework, data collection and preprocessing, algorithm selection and implementation, user interface design, and user testing and evaluation. Each section outlines the systematic approach taken to ensure that the tool is effective, user-friendly, and conducive to enhancing the creative process for poets.

4.2. Design Framework

The design of the NLP tool was guided by a user-centered approach, emphasizing the importance of understanding the needs and preferences of poets. To this end, we conducted preliminary interviews with a diverse group of poets, ranging from novices to published authors. These interviews revealed key insights into the creative challenges faced by poets, including writer's block, difficulty in finding the right words, and the desire for more engagement with their poetry.

Based on this feedback, we established a design framework that focused on three main components:

1. **User Engagement:** The tool must facilitate an interactive experience, allowing poets to engage with the content dynamically.
2. **Feedback Mechanisms:** Incorporating real-time feedback is crucial for helping poets refine their work and explore new directions.
3. **Creative Freedom:** The tool should promote experimentation and creativity without imposing rigid structures or constraints.

4.3. Data Collection and Preprocessing

To train the NLP models effectively, we required a robust dataset of poetic texts. Our data collection process involved sourcing a diverse range of poetry from public domain texts, contemporary poets, and literary anthologies. We aimed for a balanced representation of different styles, themes, and forms, including sonnets, free verse, haikus, and more.

4.3.1. Data Sources

The primary sources for our dataset included:

- **Public Domain Poetry:** Collections from classic poets such as Emily Dickinson, Walt Whitman, and Robert Frost.
- **Contemporary Anthologies:** Selections from modern poets to capture current trends and styles in poetry.
- **Online Poetry Platforms:** Data from platforms like Poetry Foundation and Wattpad, which feature a wide array of poetic voices.

4.3.2. Preprocessing

The collected texts underwent rigorous preprocessing to ensure data quality and relevance. This involved:

- **Text Normalization:** Converting all text to lowercase and removing punctuation and special characters to standardize input.
- **Tokenization:** Breaking down the text into individual words and phrases to facilitate analysis.
- **Lemmatization:** Reducing words to their base or root forms to enhance the model's understanding of language.

4.4. Algorithm Selection and Implementation

With the dataset prepared, we proceeded to select suitable NLP algorithms for implementation. After extensive literature review and evaluation of existing models, we opted for a combination of recurrent neural networks (RNNs) and transformer architectures, particularly the GPT-3 model, due to their proven effectiveness in generating coherent and contextually relevant text.

4.4.1. Model Training

The training process involved fine-tuning pre-existing models on our curated poetic dataset. Key steps included:

- **Hyperparameter Tuning:** Adjusting learning rates, batch sizes, and other parameters to optimize model performance.
- **Cross-Validation:** Employing k-fold cross-validation to ensure the model's robustness and generalizability across different poetic forms.

4.4.2. Feature Development

We developed a range of features to enhance the user experience:

- **Thematic Suggestion Generation:** Utilizing topic modeling techniques to identify prevalent themes within the user's input and suggesting relevant topics.
- **Stylistic Analysis:** Implementing tools to analyze poetic devices such as meter, rhyme schemes, and imagery, offering poets insights into their stylistic choices.

4.5. User Interface Design

The user interface (UI) was designed with a focus on accessibility and ease of use. We aimed to create a visually appealing and intuitive layout that encourages creativity. Key elements of the UI include:

- **Interactive Text Editor:** A real-time editing space where poets can compose their work and receive immediate feedback.
- **Suggestion Panel:** A dedicated area displaying thematic and stylistic suggestions based on the content being created.
- **Customization Options:** Allowing users to adjust settings such as feedback frequency and suggestion types to suit their personal preferences.

4.6. User Testing and Evaluation

To assess the effectiveness of the tool, we conducted a series of user testing sessions with participants ranging from amateur poets to established writers. The testing aimed to gather qualitative and quantitative feedback on the tool's functionality, usability, and overall impact on the creative process.

4.6.1. Testing Methodology

Participants were asked to engage with the tool over multiple sessions, focusing on specific poetic tasks. Data was collected through:

- **Surveys:** Pre- and post-test surveys to gauge user satisfaction and perceived benefits.
- **Observational Studies:** Researchers observed participants as they interacted with the tool, noting behaviors, challenges, and moments of inspiration.

4.6.2. Findings

Preliminary findings indicate that users found the tool to be a valuable resource in overcoming creative blocks. Many reported that the real-time feedback encouraged them to experiment with new poetic forms and structures. Participants also highlighted the importance of the suggestion features, which they felt enriched their writing process and broadened their thematic exploration.

4.7. Conclusion

The methodology outlined in this chapter describes a comprehensive approach to developing an interactive NLP tool for assisting poets in real-time composition. Through careful data collection, algorithm selection, user interface design, and rigorous testing, we have created a platform that not only supports the technical aspects of poetry writing but also enhances the creative journey. The insights gained from user testing will inform future iterations of the tool, ensuring it continues to evolve in alignment with the needs of poets.

Chapter 5: Implementation and Evaluation of the Interactive NLP Tool

5.1. Introduction

The development of the interactive Natural Language Processing (NLP) tool for assisting poets in real-time composition represents a significant intersection of technology and artistry. This chapter details the implementation process, from initial design considerations to the methodologies used for evaluating the tool's effectiveness. We will explore the technical architecture, user interface design, and user testing procedures, as well as the feedback received from participants.

5.2. Technical Architecture

5.2.1. NLP Model Selection

The backbone of our tool is based on advanced NLP models that have demonstrated efficacy in understanding and generating poetic language. We opted for a transformer-based architecture, specifically fine-tuning models like GPT-3, which excel in context-aware text generation. The model

was trained on a diverse dataset comprising various poetic forms, styles, and themes, ensuring a broad understanding of the nuances of poetry.

5.2.2. System Design

The system architecture consists of three primary components: the user interface (UI), the NLP processing engine, and the feedback loop mechanism. The UI is designed to be user-friendly, allowing poets to input text easily, receive suggestions, and interact with the tool seamlessly. The NLP engine processes user input in real time, generating suggestions and feedback based on the poetic context.

5.2.3. Integration and Deployment

To facilitate easy access and usability, the tool is deployed as a web application. We utilized frameworks such as Flask for the backend and React for the frontend, enabling a responsive design that adapts to various devices. The application is hosted on cloud services to ensure scalability and reliability, allowing multiple users to access the tool simultaneously.

5.3. User Interface Design

5.3.1. Design Principles

The UI design is grounded in principles of simplicity and intuitiveness. We aimed to create an environment that minimizes distractions while maximizing creative flow. Key design elements include a clean layout, easily navigable menus, and visually appealing aesthetics that reflect the artistic nature of poetry.

5.3.2. User Interaction

Users can input their poetic lines in a designated text area. As they type, the tool analyzes the text and provides real-time suggestions, including alternative word choices, thematic prompts, and structural recommendations. A sidebar displays analytical feedback, such as rhythm and meter analysis, allowing poets to refine their work effectively.

5.3.3. Accessibility Features

Recognizing the importance of inclusivity, we incorporated accessibility features, such as adjustable font sizes, high-contrast modes, and screen reader compatibility. These enhancements ensure that poets with varying abilities can engage with the tool fully.

5.4. User Testing Methodology

5.4.1. Participant Recruitment

To evaluate the tool's effectiveness, we recruited a diverse group of participants, including novice poets, experienced writers, and educators in creative writing. This diversity allowed us to gather a wide range of perspectives on the tool's usability and impact on the creative process.

5.4.2. Testing Procedures

Participants engaged in a series of structured tasks using the tool, such as composing a poem based on specific themes or styles. We observed their interactions, noted their engagement levels, and collected qualitative feedback through post-task interviews. Additionally, quantitative data was gathered through surveys assessing user satisfaction and perceived usefulness.

5.4.3. Data Analysis

Qualitative data from interviews were analyzed using thematic analysis, allowing us to identify common patterns and insights regarding the user experience. Quantitative survey results were statistically analyzed to measure overall satisfaction and the tool's impact on creativity.

5.5. Findings and Discussion

5.5.1. User Engagement

Initial findings indicate that participants experienced heightened engagement while using the tool. Many noted that the real-time suggestions helped alleviate writer's block and sparked new ideas. The interactive nature of the tool encouraged exploration and experimentation with language, leading to richer poetic compositions.

5.5.2. Feedback Mechanisms

Users reported that the feedback mechanisms, particularly the analytical tools, provided valuable insights into their writing. Many participants expressed that understanding aspects such as meter and rhyme helped them refine their poetic techniques and develop a deeper appreciation for the craft.

5.5.3. Challenges and Limitations

While the feedback was overwhelmingly positive, some participants noted challenges, particularly regarding the tool's suggestions. Occasionally, the suggestions were perceived as overly generic or misaligned with the poet's intended style. This highlights the need for ongoing refinement of the NLP model to better tailor suggestions to individual user preferences.

5.6. Conclusion

In summary, the implementation of the interactive NLP tool marks a significant step forward in merging technology with poetic creativity. The positive response from users underscores the tool's potential as a valuable resource for poets seeking to enhance their craft. Future iterations will focus on refining the NLP algorithms, expanding features, and incorporating user feedback to create an even more effective and engaging tool for real-time poetic composition. As we continue to explore the intersection of technology and the arts, we remain committed to fostering creativity and innovation in the realm of poetry.

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