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Research Article

Natural Language Processing of Gemini Artificial Intelligence Powered Chatbot

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Abstract

Natural Language Processing (NLP) created Gemini AI-powered chatbot, a powerful tool that assists humans in many sectors. This article explains the Natural Language Processing in Gemini from various theories from books and papers along with usage examples from different education sectors. This article will analyze 20 kinds of literature on the topic categorized in NLP, AI, and Gemini AI-powered chatbot. NLP lets AI communicate naturally and as humanely as possible when interacting. The findings of this article is 1) Primary NLP functionalities to help Gemini address a variety of client needs and ensure that it can comprehend them or make quick responses in different communication environments, methods such as machine translation and text summarization are employed; 2) Human-computer interaction (HCI): The review's goal was to determine how Gemini can have user-friendly and natural conversations through HCI principles. This includes knowing what the user wants to do, giving suitable replies, and making the interaction seem effortless; 3) Methods for managing conversations AI integrated application has a big difference in core processing with the normal software, Gemini uses an algorithm as the main power to calculate the possible response for the users and give the most suitable response regarding the request or question. Gemini uses machine learning with the information provided related to human needs, leading to more users using many discourses of human-bot. This advancement often raises a question about how Gemini works and processes data and has proven very useful for humans. Much research investigates the real usage of AI in real-life situations, however, a deeper understanding of the fundamentals of language processing by investigating further the topic of the possibilities of many Gemini usages will be unlocked.

Keywords: *Natural language processing; artificial intelligence; Gemini*

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Introduction

Gemini is the newest product of AI from Google DeepMind AI Model that is equal and competes with OpenAI ChatGPT with high competitive to be the best AI model (Coles, 2023; Perera & Lankathilake, 2023). With the high competition on both sides, it has always become a challenge to obtain as many users as possible. Thus, Google made Gemini stable with as many features as possible. A major framework that makes Gemini functional as a language model is Natural Language Processing (NLP). From the main framework itself, Gemini could be developed further into fully operational human assistance, which assists humans in daily activities. Furthermore, Gemini offers features that are very suitable for further improvement in many aspects with the ability to deep learning, reinforcement learning, and problem-solving related to digital education. Its flexibility could be adapted as a personal assistant or collaborative group.

Due to the ever-evolving nature of NLP, continuous testing and user feedback are essential for the development (Jurafsky & Martin, 2023). This aligns with the design of Gemini, an AI-powered chatbot, which facilitates a diverse user base with varying technical expertise. It is normal to say that NLP is a brand new technology in which testing is always a daily activity that many users do. These users vary from advanced users which require Gemini to develop a highly leveled code to be accessed. On the other hand, we have basic users which use Gemini to do daily activities that require thinking, such as studying, doing an assignment, and writing academic papers; one of the main users will be an educator who always dynamically changes depending on the resource and technology available. Although many teachers are expected to be able to utilize technology, especially AI, Gemini is one of the easy alternatives to study and test later in daily activities.

NLP within Gemini Artificial Intelligence (AI) powered chatbot shows a massive improvement in human life, particularly in the process of assisting humans in developing something creatively and technically where the creation is mostly adapted from various sources related to the theme and content, Gemini AI emerges as one of the tools for the people to use in helping their productivity process (Nyaaba, 2023). Despite the advantages that Gemini AI potentially provides with NLP within its brain, it has a flaw when it comes to understanding the language process made during the interaction between the users and the AI thus leading to uncertainty, and further explanation is needed to understand fully of the NLP inside Gemini AI. This article aims to describe the process of NLP within Gemini AI by exploring various literature, including books and previous articles.

Methods

In this literature review-based article, the authors focused on analyzing primarily-based works like research papers and primary documents like books authored by subject matter experts. In the development of Natural Language Processing (NLP) for the Gemini AI-powered chatbot, the author primarily analyzes relevant literature, including research articles and expert books, to understand and integrate key NLP techniques. These techniques are explored from three angles: 1) core NLP functionalities, such as machine translation and text summarization, to ensure Gemini can handle various user interactions; 2) Human and computer interaction; and 3) dialogue management approaches to enable coherent and informative conversation flow design principles to craft a natural and engaging user experience during chatbot interactions. This multifaceted approach ensures Gemini leverages NLP effectively to provide a comprehensive and user-friendly conversational experience.

Results and Discussions

In searching the literature, the main NLP methods for creating Gemini, a chatbot driven by AI, were highlighted. There were three key areas of interest in the study: 1) Primary NLP functionalities to help Gemini address a variety of client needs and ensure that it can comprehend them or make quick responses in different communication environments, methods such as machine translation and text summarization are employed; 2) Human-computer interaction (HCI): The review's goal was to determine how Gemini can have user-friendly and natural conversations through HCI principles. This includes knowing what the user wants to do, giving suitable replies, and making the interaction seem effortless; 3) Methods for managing conversations. When you look at how these conversations are guided, it becomes easy for the chatbot named Gemini to know what to say next that would correspond well enough as well as deliver more considered detail all along the discussion path, allowing the highest possible coherence together with information flow across talking points that any user might have raised during the conversation with this system.

NLP In Gemini AI-powered Chatbot

Google claims that Gemini is classified as a natural language that was developed as an assistive tool for users. This is in line with the theory of text processing in NLP, as Palmer (2010) stated in the book Handbook of Natural Language Processing Second Edition, edited by Indurkhya and Damerau. A real example of usage is shown in our educational life, in which we must collect information from many sources. Gemini AI has been shown to be very useful, but users are required to be trained beforehand. Furthermore, recent advancements in NLP

and AI, as discussed by Bender and Koller (2020) in their paper "Climbing towards NLU: On Meaning, Form, and Understanding in the Age of Data," highlight the complexities of achieving true natural language understanding (NLU). This research explores the limitations of current AI systems, including Gemini AI, in the ability to comprehend and generate human language in contextually appropriate ways. Bender et al. suggest that NLP technologies have made significant changes in human life. Thus, developing improvements is a top priority to address the shortcomings and improve AI's linguistic and contextual understanding capabilities. This underlines that NLP work inside AI should be refined to be effectively integrated into daily human productivity.

Keezhatta (2019) explained that NLP uses two basic techniques: syntactic analysis and semantic analysis. The syntactic analysis uses computer algorithms to analyze grammatical rules such as lemmatization, morphological segmentation, word segmentation, part-of-speech tagging, sentence breaking, and stemming. Lemmatization reduces inflected versions of a word to a single form, while morphological segmentation divides words into morphemes. Word segmentation divides text into discrete pieces, while part-of-speech tagging determines the part of speech for each word. Parsing involves analyzing grammar in each phrase, splitting sentences into huge chunks of text, and stemming to reduce inflected words to root forms. He also explained that semantic analysis uses computer algorithms to understand words and sentences and determine their meaning and connection. Semantic analysis approaches include named entity recognition (NER), which categorizes text into predefined classes, such as people's names or places. Other strategies include word sense disambiguation, which assigns a meaning to a word based on context, and natural language production, which uses databases to determine the language's semantic purpose. Based on the two basic techniques, it can be concluded that NLP is important in integrating AI to assist productivity, especially NLP, which is directly related to creativity.

NLP also brings Gemini to the working state with many features, which are trained to be used simultaneously with the works of NLP within Gemini. The features range from simple tasks to high-capabilities skills that require humans to perform without a human brain. As stated by Imran and Almusharraf (2024), Gemini also distinguishes these features in a wide range, of robust, and precise that has their purposes for each feature, such as:

1. Multimodal Capabilities

Gemini's most intriguing feature is the ability to comprehend many multimodal data types which are categorized into text, images, audio, and videos. This feature enables Gemini to generate data that can be processed and later provided to the users to fit the prompt given. Whether Gemini is tasked to obtain multimodal data or the users give the multimodal data that Gemini is tasked to analyze, Gemini, with these features, can provide it in a second. This feature also emphasizes that Gemini is meant to be used beyond its NLP framework but also used practically in teaching and learning (Lee, Latif, et al., 2023; Lee, Shi, et al., 2023).

2. Generative AI

As it suggests, AI comes with basic features that could generate almost any request that the users promptly ask. It has outstanding capabilities to provide a wide range of data types consisting of text, code, images, documents, and more. These features imply that Gemini is the ultimate tool for creative assignment, problem-solving, and content creation. Furthermore, Gemini is Google's latest technology that is equipped with abilities to tap into Google's search engine to subject itself to the latest and factual data based on real-world information (Portakal, 2023)

3. Advanced Performance

Technology can not be separated from performance benchmarking, and Gemini AI has peaked as the most advanced when performing many tasks (Nyaaba, 2023). Its performance is tied to Multimodality features with highly advanced intelligence in identifying data of various types. It is very useful for many users who have restricted access to digital learning tools. It is shown that Gemini could be highly beneficial for each user, as it focuses on learning a language with real-time conversations on a specific topic.

4. Danger Mitigation

Google stated that Gemini has been trained to mitigate any kind of danger that potentially leads to harmful result generation. The way this works is by inputting Gemini with potentially dangerous prompts and phrases, such as asking how to do something unethical, hate speech, or a security breach. Thus, this feature implies that Gemini responses are based on a safe dataset free of harm inquiries (Anil et al., 2023).

5. Flexibility in Communication

Gemini has many users type ranging in age and occupation, which led Google to develop Gemini with a feature to handle

different kinds of discourse that happening within the users and Gemini, it can be set as academic discussion with data to be discussed or even casual conversation that consisted of basic questions. It further offers a real experience of a human-to-human conversation and authentic learning simulation (Anil et al., 2023). Furthermore, Gemini has the ability to give personalized feedback and deeper elaboration for specific topics, specifically for educator which requires reasoning for their teaching material, Students are also able to utilize this feature to do in-depth learning for particular topics with the addition of visual and audio aids.

Google's Gemini Inventiveness is an excellent progression in Natural Language Processing since this will have many implications in the lives of English learners and even their daily routines thanks to its immense benefits over the basic English grammar-checking software and other similar applications. Besides, teachers can use different approaches in teaching students because it has an elaborative engagement with texts, pictures, sound, and vision, among other media, that involves all kinds of learning styles. Similarly, while using Gemini, the system generates creative and unique ways of learning that enhance the critical thinking process; therefore, flexibility is one of its strongest points.

Human and Computer Interaction

Human and computer interaction has drastically increased due to the rapid evolution of technology (Mishra & Koehler, 2006; Pikhart, 2020, 2021). This increase applies to major aspects of humans, including education. One of the real cases of human and computer interaction is the usage of AI. While it has many potentials to be implemented, it is still categorized as a foreign technology that requires studying, improving, and testing. The work of Holmes et al. (2019) is research that should be taken into account. In their work "Artificial Intelligence in Education: Promises and Implications for Teaching and Learning," published in "Current Trends in Technology and Science," the authors explore the use of AI in education and the emerging role of teachers. Thus, the article implies the necessity of introducing AI training programs into educators' education, which enables teachers to utilize AI tools in the classroom, including Gemini AI. According to Holmes et al., AI can improve educational outcomes dramatically, but only when educators use this technology; therefore, most of these tools remain underused.

A particular previous study by Mukhallafi in 2020 titled 'Using Artificial Intelligence for Developing English Language Teaching Learning: An Analytical Study from University Students' Perspective' was conducted quantitatively by acquiring 44 random samples at Northern Border University. the study shows that many students require training when using AI. This study examines the strategies for effectively applying AI applications to teach and learn. The study concludes that AI has brought a new and effective way of teaching English. Mukhallafi's study results, combined with Gemini features, point out a bright future for Education AI that can be promising. Having been trained on students, the need to have Gemini AI tools that are easy for a user to habituate within an educational set-up necessitates user-friendliness. By providing comprehensive support regardless of the different types of data and promoting interaction with computers while learning, Gemini can deal with the difficulties identified in Mukhallafi's study.

Moreover, many AI tools are now moving to becoming more user-friendly. One of them is Gemini, which is in line with established Human-Computer Interaction (HCI) principles. A study by Shneiderman and Plaisant (Shneiderman & Plaisant, 2005) titled "Designing the User Interface: Strategies for Effective Human-Computer Interaction" suggests central HCI principles that should be incorporated in AI tools such as Gemini. These guidelines entail an understandable and uniform user interface, suitable feedback mechanisms, as well as simplicity in acquisition and operation. Integrating these HCI principles into the app that helps educators and students learn would guarantee that it is user-friendly and thereby easy to use. In 2021, in the study entitled Adaptive E-learning Environment based on Learning Styles and its Impact on Development Students' Engagement, authors El-Sabagh showed that the customization of AI interactions is crucial. In line with this idea, Gemini can vary its communication patterns as well as offer customized feedback, making learning more fun but still competent.

How NLP Works in Gemini

A user's prompt goes through several complex steps before being well understood by the Gemini NLP System as its goal (Jurafsky & Martin, 2023). Starting from processing user input which entails an analysis of the user's words by pinpointing their grammatical functions, identifying named entities, and establishing semantic relationships between them we get to know that this is where our journey begins with this assessment being done carefully so that all necessary information can be gathered to make sense out of it. Gemini should therefore not only understand what has been said on the surface but also get at what was meant deep down i.e., the core idea or purpose that underlies queries raised by people.

User Input Processing

The interaction begins with the user providing a prompt or question (Jurafsky & Martin, 2023). Gemini's NLP system performs Natural Language Understanding (NLU) on this input,

breaking it down into its core components. This involves tasks like:

1. Tokenization

This breaks down the user's input into individual words or meaningful units. For example, the sentence "I want to learn English" would be split into separate tokens like "I," "want," "to," "learn," and "English."

2. Part-of-Speech (POS) Tagging

Here, Gemini also specifies the part of the speech to which each of the words in the resultant sentence belongs. In the given example, the word "I" has been categorized under the pronoun, "want" has been categorized under the verb, "to" has been categorized under the preposition, and "learn" has been categorized under the verb, and "English" under the noun. This goes a long way in helping Gemini learn the formatting of a sentence and how the words relate to each other.

3. Named Entity Recognition (NER)

This step is crucial in the process of parsing the user's input where we seek to find and categorize named entities. Suppose a user writes or speaks about some place, such as "Paris." In this case, the intended sense of "Paris" is certainly that of a named entity, possibly a location, and Gemini would tag it as such and save it for further processing.

4. Dependency Parsing

This stage highlights the dependency and functionality of the words within a sentence. It is not a part of speech recognition where a system only recognizes different parts of speech such as nouns, verbs, etc. For example, in the traditional parse tree of natural language processing, it is possible to unpack the word group "learn" as the verb of the sentence and the noun "English" as the object of the verb in the example of the phrase "I want to learn English." These relations will let Gemini grasp the big picture and intent of the user input in addition to correlation with the available data.

Intent Recognition and Task Understanding

By analyzing the processed input, Gemini employs techniques from machine learning to grasp the user's intent and the underlying task they wish to accomplish (Jurafsky & Martin, 2023; Manning et al., 2014). This may involve:

1. Semantic Role Labeling

Jurafsky and Martin (2023) identify the semantic roles of words within the sentence (e.g., "English" is the patient of the verb "learn"). SRL goes further than transformations defined at the sentential level: thematic roles (such as "buyer" or "instrument") are assigned to words and phrases stressing their function in the described event. Though the beliefs are found in fundamental grammar studies, it expands on them in a way that helps Gemini pinpoint the intended meaning, even if words are used differently. With these roles, Gemini can go deeper than noticing that the words 'the' and 'it' are related but not knowing what the relationships are: who did what to whom, and so on, allowing its comprehension to improve greatly.

Linguistics analysis is used within the Gemini, the AI chatbot, to understand how to respond to user's inquiries. It was one of the techniques utilized in the process of identifying and describing Thematic Role Labeling. This is not limited to dissecting the syntax of a user's report and even comprehending the purpose and importance of the words included in an event narrated by a user.

For instance, there is a situation when a user has typed, "Can you explain the difference between an agent and a theme?" In this case, the user is not looking for directions for a particular action but for the definition of two terms from the Dictionary of Linguistics. Thematic role labeling assists Gemini in defining the user as the Experiencer or he/she who is in pursuit of knowledge while "agent" and "theme" are the two Themes or the concepts that the user wants to know. In this manner, Gemini will be able to decipher the educational purpose of the user's question and provide an adequate answer regarding thematic roles.

This way, Gemini can go past the mere grammatical level and extract an actual meaning from a user's prompt. Considering such words according to the role they play in the event being discussed will help Gemini get closer to the intent behind the query and, therefore, give more accurate and valuable answers. Ultimately, SRL is a very useful technique in the Gemini NLP system. The results pointed out from the technique are highly dependable. Thus, while surface grammar can help Gemini identify the question type, SRL enables it to go further and understand actions and thematic roles behind acts of an event for intent. This allows Gemini to classify the user's intent, which can be to acquire information, clarify some idea, or accomplish something completely different. Thus, the revealed improved understanding allows Gemini to provide more useful, helpful, and, as a result, beneficial responses to user's queries.

2. Discourse Analysis (DA)

Discourse analysis in Gemini defines the understanding of the context and flow of the conversation to infer the user's goal. According to Paltridge (2012) and Woods (2006) Discourse analysis is the analysis of the language in use where specific attention is paid to what people do with it in the real social and cultural world. It examines it in terms of processes across spoken, written, and signed language and how this usage helps

define and reflect on the participants' world and social phronesis. It looks at how meaning is built up from word to word, from sentence to sentence, what happens between texts, and how language use participates in these processes and in shaping the positions of these identities/political subjects and their relations. There are two main approaches: looking first at the contextual facts and then at the way language is used or, in their turn, looking first at the language and then at the context albeit most interpretations seem to partake a mixture of both.

Gemini NLP uses techniques of DA to improve its comprehension of natural language. The ability to process contextual data and the dynamic of a conversation will let Gemini understand the user's aims and objectives better and enhance the conversation's effectiveness, even if the conversation is detailed and structured. An example is linked to goal recognition, which can be difficult as users rarely make their goals clear in a Human-Computer Interaction scenario. In the discourse analysis process, Gemini can also identify unspoken requests for action or requests hidden in the actual text of the user, thus addressing their needs better. Since Gemini is designed to converse with users, it has to understand the difference between literal and sarcastic or humorous statements, which is made possible through discourse analysis.

Discourse analysis also enables Gemini to identify variations of genre and style to a certain level. It is important to note that the language can also be utilized differently depending on the type of communication and context, for example, the official e-mail and the conversation in Messenger. This is because Gemini is fully aware of such a distinction and seeks to address all distinct communication settings in due course. Another important factor is identifying conversation threads, helping Gemini to have a logical flow within a conversation, in case subjects and references change, as well as deepen. Besides, it helps to determine the emotions of the interlocutor by analyzing the language used by the user and answering the perceived emotional state or need of the user, which also serves to enhance interaction with Gemini.

In conclusion, discourse analysis integration remains an important function of Gemini's NLP framework. This value advantage enables Gemini to push past the simple recognition and more contextually realistic discussions. Thus, using discourse analysis, Gemini improves the way it presents itself to users, aiming to create a more natural and sincere ambiance.

3. Machine Learning Models

Gemini utilizes the use of pre-trained machine learning models to reveal the user's intention behind what they say. These models, which were trained on large volumes of text and code, can label users' objectives with formidable precision. Is what the user has typed in a question looking for information, or is it a request for a specific task such as creative text generation? By this means, Gemini Machine Learning Models can effectively categorize these aims by analyzing the input against its vast internal knowledge base leading to personalized answers that are informative too. (e.g., is the user asking a question, requesting a specific task like generating creative text, or seeking information?).

Response Generation

Once Gemini understands the user's intent and task, it leverages Natural Language Generation (NLG) techniques to formulate a response (Jurafsky & Martin, 2023; Vaswani et al., 2017). This may involve:

1. Text Generation

Using pre-trained Large Language Models (LLMs) like those described by Vaswani et al. (2017), Gemini generates human-quality text that addresses the user's request.

2. Information Retrieval

If the user seeks factual information, Gemini might access and process relevant data sources and present them clearly and concisely.

3. Multimodal Response

Gemini might utilize its multimodal capabilities to generate audio, video, or image content alongside text, depending on the user's request and the most appropriate learning style.

Feedback Loop and Adaptability: Gemini's response is then delivered to the user. Ideally, user feedback (explicit or implicit) can be integrated into future interactions to improve its performance and adapt to individual user needs.

Ultimately, the turn of events comes to an end with the return of information to humans. The idea is that this customer-organization relationship creates reciprocal communication whereby the reimbursements and penalties for gems are directly integrated into the user's experience. This will continue to provide Gemini with a wider range of customers, starting from its capacity to answer hard questions, which makes it an essential part of human existence.

Conclusions

This analysis of Gemini, an AI-powered chatbot, reveals the significant role of Natural Language Processing (NLP) in its development, highlighting three key areas of empowerment: NLP processes, HI, and dialogue states to be used in human-computer communication. Tools like machine translation and text summarization enable Gemini to systematically address user interactions in several contexts. Hence, the application of

HCI principles in Gemini enables natural and welcoming conversation experiences, guessing the user's intention and managing the interlocutions' flow. Evaluating dialogue management strategies makes it possible for Gemini to sustain conversation topics and formats for users' interaction while providing them with accurate and organized outputs. The discussion also threw light on the continual innovation that is being made in the subject of NLP and the problems still present in current AI that hinder them from emulating an NLU. Even though user training can help with the improvement of tools such as Gemini, the constant improvement of how the AI can comprehend and answer in context is important. In a nutshell, Gemini seems to be one of the most valuable tools in today's NLP that can shape human life, specifically education, on multiple levels. That is why its options for working with multimodal data combined with the generation of new variants of the text's format and individual feedback make it useful for educators and learners. According to current advancements in natural language processing regarding artificial intelligence, the facet of chatbots such as Gemini will continue to improve in its interaction with individuals who are undertaking human computation.

Recommendations

Gemini's NLP functionalities have the potential to revolutionize education. For further exploration, a need was felt to conduct user studies that can appraise its efficacy in real-life scenarios. This can also help build user confidence and meet different learning styles, especially if it also considers research on explanations, bias reduction, and multimodal accessibility. Additionally, having lifelong learning mechanisms will ensure that the AI continuously builds upon user interactions, ensuring that it doesn't lose any progress made on an ongoing basis.

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