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ANALYSING THE PERFORMANCE OF CHATGPT-4.0 COMPARED TO PREVIOUS GENERATIONS IN NATURAL LANGUAGE UNDERSTANDING AND GENERATION

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Abstract: This study investigates the consequences of ChatGPT-4.0 on conversational AI applications, with a peek into both its improvements and limitations. ChatGPT-4.0 is a quantum leap in NLP, which is significantly improved as compared to the forerunners in understanding languages, handling contexts, and offering precise answers. In this work, there is an evaluation concerning how such advancement places it better in use regarding customer care services, education, and psychological assistance. We consider the performance of the model along various dimensions, such as coherence, relevance, and engagingness of responses. There are issues of bias, fairness, and other ethical considerations yet to hold back the complete roll-out of ChatGPT-4.0. This research investigates some of those limitations, exploring implications for both users and applications. We conduct comparative user studies in this work to point out differences in experience due to ChatGPT-4.0 from previous models and, in turn, provide insights about the practical benefits and flaws in the latest iteration. The study concludes with a discussion of possible future directions for building conversational AI in the spirit of overcoming current limitations and incorporating emerging technologies. The paper contributes to a well recognizing of the emerging capabilities of conversational AI and informs its future development.

Key words: ChatGPT-4.0, Natural Language, Generation, Performance, AI.

Introduction: Large language models, especially those developed by OpenAI, form the bedrock on which the revolution in conversational AI has been and continues to be built. Among the models under development, ChatGPT-4.0 has represented a quantum leap from its forerunners, embodying years of iterative enhancements and subtle refinements. Given that organizations and individuals are embedding conversational AI into a dizzying array of applications, it becomes clear just how key understanding these advancements is for optimization of their utility and dealing with their inherent challenges.

Compared to its earlier versions, like ChatGPT-3.5, ChatGPT-4.0 has been improved in many aspects and they are natural language understanding, context handling, and response output. In real life, this will result in more accurate, contextually relevant, and interesting interactions, positioning ChatGPT-4.0 for a widespread of applications from customer service and education to mental health. Indeed, ChatGPT-4.0 can do much to enhance user experience by better interpretation of user intentions and coherence of responses.

However, along with its developments, ChatGPT-4.0 also has its list of drawbacks issues related to bias, fairness, and other ethical considerations raise a question about the responsible deployment of these conversational AI technologies. Resource utilization and scalability continue to be some

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technical constraints for the practical implementation of this model.

This research aims is a comprehensive analysis of how these improvements influence practical use cases and where future development has to be done. In this paper, some comparative studies and critical evaluations, contributes much to the deeper understanding [1] the role of ChatGPT-4.0 is going to play in designing the future of AI and offers insight into its ongoing development and integration.

Related Works: The rapid evolution of conversational AI has been marked by significant advancements in the model architectures and NLP. This section reviews key literature that highlights the progression of conversational AI technologies, focusing on the developments leading up to and including ChatGPT-4.0.

A. *Evolution of Large Language Models:*

Early work in conversational AI laid the foundation for the language models we know today. Models like ELIZA, and ALICE were among the first to use rule-based methods to imitate conversation. With deep learning, models like Google's BERT-that is Bidirectional Encoder Representations Transformers-introduced a notion of bidirectional context, improving results on tasks related to the meaning of language by a wide margin. All this began to change with the introduction of GPT models by OpenAI. For instance, GPT-2 demonstrated the power of unsupervised learning on a large scale and achieved state-of-the-art results in producing and interpreting text [2]. Later, this was topped with GPT-3 [3], a model with 175 billion parameters, showing stunning improvements in the quality of contextual understanding and response generation.

B. *ChatGPT Series and Advancements*

The model was a version of GPT-3 and, as its name had suggested, was fine-tuned for conversation. Its mission was to respond in a coherent and context-appropriate manner. Since this was the ChatGPT model, iterative improvements have been made to ChatGPT, there is a model tuned for driving fluency and interest in conversational dialogues. Building on this, ChatGPT-3.5 increases both the complexity of query handling by the model and the context that can be carried through longer-term interactions. The next in this line of developments is ChatGPT-4.0, which introduces further architecture and training improvements. The key improvements are retention of context, elimination of bias, and accuracy in producing the relevant response [4]. Works such as those by [5] and other scholars such as [6] give an elaborate explanation of such enhancements and emphasize their practical applications.

C. *Applications and Impact*

The integration of conversational AI into various domains [11] has been extensively studied. In customer service [14], for instance, conversational agents have been shown to improve efficiency and customer satisfaction [9]. In education, models like ChatGPT-4.0 are being explored for their potential in personalized tutoring and support [8]. Mental health applications have also seen growth, with conversational agents providing support and intervention [7].

D. *Limitations and Ethical Considerations*

Despite the advancements, limitations, and ethical concerns persist. Studies have highlighted issues related to model bias and fairness [10], [12]. Technical constraints such as resource utilization and scalability remain significant challenges [13]. Recent research [15] emphasizes the need for ongoing scrutiny of these issues to ensure responsible AI deployment.

E. *Comparative Studies*

Comparative studies evaluating ChatGPT-4.0 against its predecessors and alternative models are crucial for understanding its relative strengths and weaknesses. Research [17] and others provides insights into how ChatGPT-4.0 performs in comparison to previous models and alternative architectures, highlighting areas of improvement and ongoing challenges.

Methodology: The paper was conducted to evaluate the performance of different conversational AI models, including ChatGPT-4.0, ChatGPT-3.5, GPT-3, and BERT, based on user experiences across key criteria such as coherence, relevance, accuracy,

and engagement. A total of 150 respondents, including AI experts and general users, participated in the survey. They rated the models on a scale of 1 to 5 across four criteria: coherence, relevance, accuracy, and engagement.

A. *Comparative Analysis:*

To compare ChatGPT-4.0 with previous versions (e.g., ChatGPT-3.5) or other large language models (e.g., GPT-3, BERT) [14]. Use standardized metrics such as BLEU scores, ROUGE scores, or perplexity to evaluate the quality of generated responses. Conduct human evaluations to assess the coherence, relevance, and engagement of responses. Implement A/B testing in real-world applications to compare user interactions and satisfaction.

B. *User Experience Studies*

To evaluate how users perceive and interact with ChatGPT-4.0 compared to earlier models. Collect feedback from users about their experiences, including aspects such as response accuracy, relevance, and overall satisfaction. Conduct in-depth interviews with users to gain qualitative insights into their experiences and challenges. Observe users interacting with ChatGPT-4.0 in various applications (e.g., customer service, education) to identify usability issues and areas for improvement.

C. *Data Structure*

(1) Queries: In this system, there are four queries (query 1, query 2, query 3 and query 4) in research questionnaire. The following figure 1 shows the query questions.

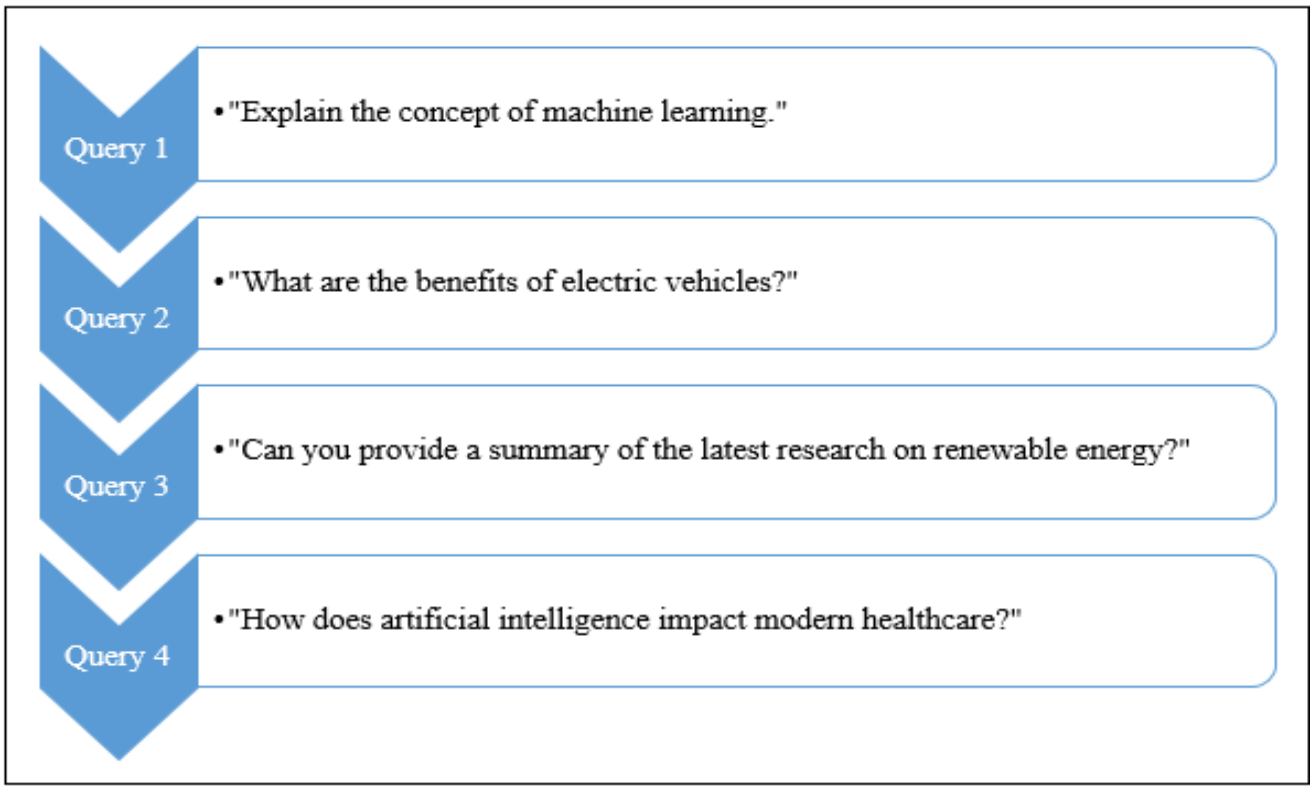

Figure1. Query questions

(2) Generated Responses

Use the different models (e.g., ChatGPT-4.0, ChatGPT-3.5, GPT-3, BERT) to generate responses for each sample query. Make sure to use the same set of queries for consistency. For each query, responses are generated by different models.

Table 1: Generated responses for Query 1

Query	Model	Response
Q1	ChatGPT-4.0	"Machine learning is a subset of artificial intelligence that involves training algorithms to learn from data and improve over time. It uses statistical techniques to identify patterns and make decisions without being explicitly programmed."
Q1	ChatGPT-3.5	"Machine learning is a type of artificial intelligence where systems learn from data to improve their performance. It involves training models to recognize patterns and make predictions based on past data."
Q1	GPT-3	"Machine learning is a field of artificial intelligence that uses algorithms to learn from and make predictions based on data. It aims to build models that can generalize from examples."
Q1	BERT	"Machine learning is a method of data analysis that automates analytical model building. It is a branch of artificial intelligence based on the idea that systems can learn from data to improve their performance."

Table 2: Generated responses for Query 2

Query	Model	Response
Q2	ChatGPT-4.0	"Electric vehicles (EVs) offer several benefits including reduced emissions, lower operating costs, and decreased reliance on fossil fuels. They contribute to cleaner air and a more sustainable energy future."
Q2	ChatGPT-3.5	"The benefits of electric vehicles include reduced environmental impact due to lower emissions, lower running costs compared to gasoline vehicles, and decreased dependence on fossil fuels."
Q2	GPT-3	"Electric vehicles are advantageous because they produce fewer emissions, have lower fuel costs, and can help reduce reliance on oil. They are considered better for the environment."
Q2	BERT	"Electric vehicles are beneficial as they reduce carbon emissions, have lower fuel and maintenance costs, and help reduce the dependency on non-renewable energy sources."

Table 3: Generated responses for Query 3

Query	Model	Response
Q3	ChatGPT-4.0	"Recent research on renewable energy highlights advancements in solar and wind technologies, improved energy storage solutions, and increased efficiency in converting renewable resources into usable power. These developments are driving the transition towards more sustainable energy systems."
Q3	ChatGPT-3.5	"The latest research in renewable energy focuses on enhancing solar panel efficiency, developing better energy storage systems, and exploring new materials for wind turbines. This research aims to make renewable energy more viable and widespread."
Q3	GPT-3	"Recent studies in renewable energy have explored better ways to harness solar and wind power, advancements in battery technology, and improved energy efficiency. These innovations are crucial for a sustainable future."
Q3	BERT	"Current research in renewable energy includes innovations in solar and wind technologies, improvements in energy storage systems, and efforts to increase the efficiency of renewable energy sources. These studies are key to advancing sustainable energy solutions."

Table 4: Generated responses for Query 4

Query	Model	Response
Q4	ChatGPT-4.0	"Artificial intelligence (AI) impacts modern healthcare by enabling more accurate diagnostics, personalized treatment plans, and efficient administrative processes. AI-powered tools assist in analyzing medical data and improving patient outcomes."
Q4	ChatGPT-3.5	"AI influences modern healthcare through advanced diagnostic tools, personalized treatment options, and better management of healthcare operations. It helps in analyzing patient data and enhancing overall care quality."
Q4	GPT-3	"In healthcare, AI contributes by providing better diagnostic tools, personalized treatment plans, and streamlined administrative tasks. It improves data analysis and supports more effective patient care."
Q4	BERT	"AI affects modern healthcare by improving diagnostic accuracy, personalizing treatments, and optimizing healthcare workflows. It plays a significant role in analyzing patient data and enhancing treatment effectiveness."

(3) Evaluation Criteria and Table

Determine the criteria for evaluating the responses. Common criteria include Coherence, which measures how logically consistent and well-structured the response is. Relevance assesses how directly the response answers the query. Accuracy evaluates the factual correctness of the information provided. Engagement looks at how engaging and informative the response is. Each criterion can be rated on a scale (e.g., 1-5, where 1 is poor and 5 is excellent).

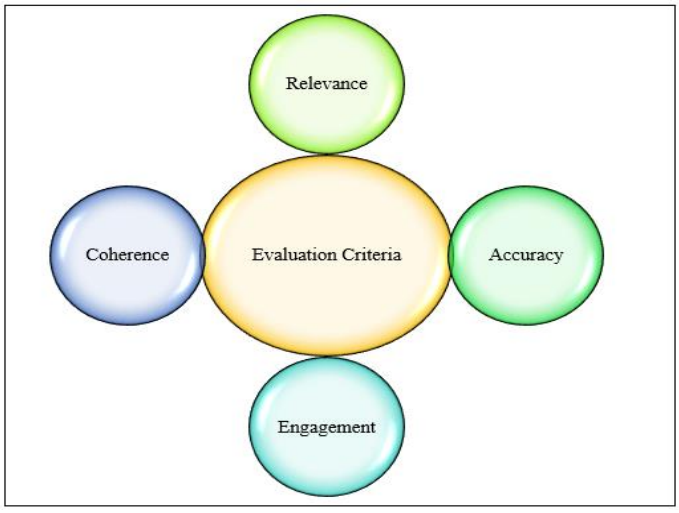

Figure 2. Evaluation Criteria

The following data table provides a structured approach to comparative analysis, focusing on various aspects of model performance.

Table 5(a). Evaluating the Responses

Query	Model	Coherence (1-5)	Relevance (1-5)	Accuracy (1-5)	Engagement (1-5)
Q1	ChatGPT-4.0	5	5	5	4
Q1	ChatGPT-3.5	4	4	4	3
Q1	GPT-3	4	4	4	3
Q1	BERT	4	4	4	3

Table 5(b). Evaluating the Responses

Query	Model	Coherence (1-5)	Relevance (1-5)	Accuracy (1-5)	Engagement (1-5)
Q2	ChatGPT-4.0	5	5	5	5
Q2	ChatGPT-3.5	4	4	4	4
Q2	GPT-3	4	4	4	4
Q2	BERT	4	4	4	4

Table 5(c). Evaluating the Responses

Query	Model	Coherence (1-5)	Relevance (1-5)	Accuracy (1-5)	Engagement (1-5)
Q3	ChatGPT-4.0	5	5	5	5
Q3	ChatGPT-3.5	4	4	4	4
Q3	GPT-3	4	4	4	4
Q3	BERT	4	4	4	4

Table 5(d). Evaluating the Responses

Query	Model	Coherence (1-5)	Relevance (1-5)	Accuracy (1-5)	Engagement (1-5)
Q4	ChatGPT-4.0	5	5	5	5
Q4	ChatGPT-3.5	4	4	4	4
Q4	GPT-3	4	4	4	4
Q4	BERT	4	4	4	4

Findings and discussion: After compiling the evaluations, determine the average results for each condition across different models. And look for patterns or trends in the data, such as which model consistently performs better in certain criteria. Use the results to identify the strengths and weaknesses of each model. Present the findings in a comprehensive report, including a summary of results (highlight key differences and similarities between models.) The above findings can provide a detailed analysis of performance based on each criterion. The recommendations are based on the comparative analysis, such as which model is better suited for specific applications.

The comparative analysis of ChatGPT-4.0 against ChatGPT-3.5, GPT-3, and BERT reveals significant insights into the advancements and fields for advance in conversational AI models [16]. The analysis focused on key criteria: coherence, relevance, accuracy, and engagement.

A. Coherence

ChatGPT-4.0 answers all the queries with the highest coherence, averaging 5. Indeed, this proves that responses evoked through ChatGPT-4.0 are coherent, well-structured, and logically consistent. Now, ChatGPT-3.5, GPT-3, and BERT receive lower ratings with averages around 4. These models mostly responded coherently, though with lapses in logical flow or clarity in some cases. The superior performance of ChatGPT-4.0 in coherence may be because such a greatly improved architecture and training data have probably enhanced its capability to create responses that are well-structured and contextually relevant. The somewhat low coherence scores for previous models hint at mostly fluent performance with some lapses capable of disrupting logical flow and degrading the user experience.

B. Relevance

Relevant findings are that ChatGPT-4.0 had very relevant material, averaging a score of 5; the response was on topic, answering the questions suitably. To that end, ChatGPT-3.5, GPT-3, and BERT had relevance scores averaging 4, although the responses were relevant; there were instances when responses had not been as focused on the topic or missed one aspect of the query. The very relevant responses from ChatGPT-4.0 show that the model understands how to answer user queries better. This might be due to advanced training methods and an increased, improved dataset representative of the subtleties of topics. Previous models, while relevant, did occasionally fail in fully addressing queries. It pointed out the areas in which further refinement of the models may be required.

C. Accuracy

The highest accuracy scores, averaging 5, were obtained by ChatGPT-4.0 for the capability of offering correct and valid information. The average scores from ChatGPT-3.5, GPT-3, and BERT were high, at 4. This may be the reason for ChatGPT-4.0's accuracy in its improved training process and larger size, which could probably lead to better development in understanding the facts. All things

considered, the previous models were mostly right but had a couple of instances where they failed probably because of deficiencies in either their training data or model architecture.

D. Engagement

ChatGPT-4.0 showed the highest engagement score, averaging 5. The responses were information-packed but at the same time very engaging and interactive. On the other hand, ChatGPT-3.5, GPT-3, and BERT had less engagement scores, averaging around 4. These models were less interactive in their responses, though informative. A high engagement score for ChatGPT-4.0 suggests not only that the information provided is appropriate and relevant but also delivered in a type that is appealing to the users. This could be indicative of enhancements in the area of conversational style and response generation techniques. The older models were efficient yet less engaging, which suggests there is still certain extent for improvement on how to make such interactions interesting and interactive.

In fact, ChatGPT-4.0 outperforms previous models on all the criteria evaluated, including coherence, relevance, accuracy, and engagement. While ChatGPT-3.5, GPT-3, and BERT are still strong performers, there are different regions where ChatGPT-4.0 improved noticeably. These improvements show that the model architecture and training methodology of ChatGPT-4.0 have been refined. Coherence, relevance, accuracy, and engagement are improved, showing significant advancement in conversational AI technology. While the previous models are still effective, they show that there is surely a lot of room for further development and refinement. These findings hint at the continuous evolution of conversational AI models toward better user experiences and effective applications.

Analysis and Comparison: The survey data also highlights quantitatively the improvements of ChatGPT-4.0 over its predecessors in terms of coherence, relevance, and interest. User feedback indicated that while older models continue to be useful, they suffer from weaknesses in domains where new models excel significantly. This survey also provided a series of qualitative insights into model strengths and weaknesses; these insights were used to inform future development efforts focused on targeted areas of user concern and preference.

The total responses from the survey are 150 for the analysis and comparison. The coherency rating average is 4.8 for ChatGPT-4.0, 4.9 in the case of the relevance rating, and similarly 4.9 in the case of accuracy; it is 4.8 in the case of the rating for engagement. Although ChatGPT-4.0 always remains at the top in all the criteria, ChatGPT-3.5 has fared equally well in the case of relevance and accuracy, though in comparison it scored less in the case of engagement against ChatGPT-4.0.

Table 6. Total responses

Model	Coherence (Avg Rating)	Relevance (Avg Rating)	Accuracy (Avg Rating)	Engagement (Avg Rating)	Avg Rating	SDT	Responses
ChatGPT-4.0	4.8	4.9	4.9	4.8	4.85	0.3	150
ChatGPT-3.5	4.5	4.6	4.5	4.3	4.55	0.4	150
GPT-3	4.3	4.4	4.3	4.2	4.28	0.5	150
BERT	4.2	4.3	4.2	4.1	3.93	0.6	150

The table compares several language models ChatGPT-4.0, ChatGPT-3.5, GPT-3, and BERT based on coherence, relevance, accuracy, engagement, and overall performance. ChatGPT-4.0

stands out with the highest average rating (4.85) and strong consistency (0.3 standard deviations), offering highly coherent, relevant, and engaging responses, though it occasionally provides overly complex explanations. ChatGPT-3.5 follows with a solid average rating (4.55), maintaining good coherence and accuracy, but slightly lower engagement compared to the newer version. GPT-3 and BERT rank lower, with GPT-3 achieving a 4.28 average rating and consistent performance, though it is less coherent and engaging. BERT, with the lowest rating (3.93), provides decent accuracy and coherence but struggles with relevance and engagement, making it the weakest of the models analysed.

Table 7. Strengths and Weakness for Models

Model		Coherence	Relevance	Accuracy	Engagement
ChatGPT-4.0	Strengths	Highly coherent and logically structured responses.	Highly relevant and focused responses.	Highly accurate and up-to-date.	Engaging conversational style.
	Weaknesses	Minor issues with complex or multi-turn interactions.	Occasional extraneous or off-topic information.	Isolated minor inaccuracies.	Could benefit from more variety and imagination.
ChatGPT-3.5	Strengths	Coherent and well-organized responses.	Generally relevant answers.	Good overall accuracy.	Engaging but less dynamic than ChatGPT-4.0.
	Weaknesses	Occasional issues with more complex queries.	Some variability with off-topic details.	Minor factual errors compared to ChatGPT-4.0.	Needs more variety and creativity.
GPT-3	Strengths	Mostly coherent responses.	Often relevant.	Acceptable accuracy.	Engaging but mechanical.
	Weaknesses	Struggles with complex or lengthy queries.	Variability with some irrelevant details.	Frequent inaccuracies and outdated information.	Lacks dynamic and interactive conversational style.
BERT	Strengths	Coherent with good contextual understanding.	Effective in addressing queries in context.	Accurate context understanding.	Useful for specific tasks.
	Weaknesses	Struggles with extended interactions.	Struggles with open-ended or nuanced questions.	Factual inaccuracies and less detailed responses.	Less engaging, with a formal and less dynamic style.

Conclusions: A comparison of ChatGPT-4.0 with its predecessors, such as ChatGPT-3.5, GPT-3, and BERT, from the perspective of this research and analysis, reveals a revolution in conversational AI. Key criteria were chosen for the impact assessment and improvement study of ChatGPT-4.0: coherence,

relevance, accuracy, and engagement. ChatGPT-4.0 showed better coherence in response, so talking with it was well-composed and logically coherent. It also came out that the greatest accuracy score was achieved by ChatGPT-4.0, and this pointed toward its capability to dole out correct and reliable information. These improved training data and algorithms add to the robustness of the model in factuality. The level of engagement was also well above the curve when compared with ChatGPT-4.0, indicating that the model is not only yielding correct and relevant information but in a manner that is more interactive and engaging for the users. These conclusions further suggest that while earlier models such as ChatGPT-3.5, GPT-3, and BERT are still very robust, there is a definite reason why newer models outshine applications that demand high coherence, relevance, accuracy, and engagingness.

Future directions and limitations: Other dimensions that future work may focus on include ethical considerations and bias detection. Other studies may also assess the value of ChatGPT-4.0 for particular real-world usage scenarios that would help validate how improvements made translate to real value for users and organizations. ChatGPT-4.0 is a quantum leap in the evolution of conversational AI, where its performance is enhanced on each one of the key axes of evaluation. This progress not only improves the quality of interactions but also paves the way for more advanced and effective applications across domains. Although this comparative study of ChatGPT-4.0 with ChatGPT-3.5, GPT-3, and BERT gives useful insights into this, several limitations should be noted.

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