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Initial Output:

Title: The Evolution of Artificial Intelligence: From Turing to Large Language Model Chatbots

Abstract:

This paper presents a comprehensive overview of the development of artificial intelligence (AI) from its early beginnings with Alan Turing's groundbreaking work to the modern era of large language model chatbots. We trace the key milestones and innovations that have shaped the field of AI over the past 70 years, including the Turing Test, ELIZA, expert systems, machine learning, deep learning, and the emergence of AI in everyday life. We also examine the impact of AI on society and the potential future directions of the field.

Introduction

Early Beginnings: Alan Turing and the Turing Test

The Birth of Chatbots: ELIZA

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Deep Learning and the Emergence of Neural Networks

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Introduction:

Artificial intelligence (AI) is a rapidly developing field that has undergone significant advancements over the past 70 years. This paper aims to provide a comprehensive overview of the development of AI from its early beginnings with Alan Turing's groundbreaking work to the modern era of large language model chatbots. We will trace the key milestones and innovations that have shaped the field of AI, including the Turing Test, ELIZA, expert systems, machine learning, deep learning, and the emergence of AI in everyday life. We will also examine the impact of AI on society and the potential future directions of the field.

Early Beginnings: Alan Turing and the Turing Test:

The history of AI can be traced back to the work of British computer pioneer Alan Turing in the late 1940s. Turing was one of the first to consider the possibility of building intelligent machines and testing their intelligence. In 1950, he published a seminal paper, "Computing Machinery and Intelligence," in which he proposed the Turing Test, a method for determining whether a machine could exhibit intelligent behavior indistinguishable from that of a human being.

The Birth of Chatbots: ELIZA:

In the 1960s, the first chatbot, ELIZA, was developed by Joseph Weizenbaum at MIT. ELIZA was a simple program that simulated conversation by using pattern matching and substitution to generate responses to user input. Despite its limitations, ELIZA was a groundbreaking

development in the field of AI and laid the groundwork for future advancements in natural language processing and chatbot technology.

Expert Systems and the Rise of Machine Learning:

In the 1980s, expert systems emerged as a new approach to AI. These systems were designed to mimic the decision-making abilities of human experts by using a knowledge base of rules and heuristics. The development of expert systems paved the way for the rise of machine learning, a subfield of AI that focuses on the development of algorithms that can learn from and make predictions on data.

Deep Learning and the Emergence of Neural Networks:

In the 1990s, deep learning emerged as a powerful tool for AI research. Deep learning is a subset of machine learning that uses neural networks, which are inspired by the structure and function of the human brain. Deep learning has been instrumental in the development of AI applications such as image recognition, natural language processing, and speech recognition.

Large Language Models and the Development of AI Chatbots:

In recent years, large language models have emerged as a powerful tool for natural language processing and AI chatbot development. These models are trained on massive amounts of text data and are capable of generating coherent and contextually relevant responses to user input. This has led to the development of advanced AI chatbots that are capable of engaging in sophisticated conversations with human users.

AI in Everyday Life: The Impact of AI on Society:

AI has had a significant impact on society, with AI-powered technologies being used in a wide range of applications, from healthcare and education to transportation and finance. The development of AI has the potential to bring about significant changes in the way we live and work, and it is important for society to consider the ethical implications of these changes.

Conclusion:

In conclusion, the development of AI from Turing to large language model chatbots has been a long and complex journey. From the early beginnings of the Turing Test to the modern era of AI chatbots, the field of AI has undergone significant advancements and has had a profound impact on society. As we look to the future, it is important for us to consider the potential implications of AI on society and to ensure that the development of AI is guided by ethical considerations.

My Overall Process:

When initially tasked with this paper, I found myself at a loss for direction. While I had previous experience using Open AI for various assignments, none quite resembled the scope of this one. Writing a 2500-word research paper that not only permitted but required the use of a chatbot to compose the entire essay was completely new for me. The initial question was: “describe the development of artificial intelligence from Turing to large language model chatbots in paper format.”

I opted to diverge from my usual reliance on ChatGPT and instead experimented with Grok. However, upon inputting the question and requesting an output in “paper format,” it had only produced a 758-word paper. Initially, my strategy involved posing random questions to Grok in an attempt to expand the paper's length. Yet, I soon realized that this approach resulted in a lack of coherence and structure within the paper.

I turned to Grok, requesting a paper outline to provide a clearer sense of direction. However, the outcome fell short of my expectations. Therefore, I sought assistance from ChatGPT, specifying my desired focus on the foundations of AI, the role of women in shaping AI, the rise of Large Language Models (LLMs), and their projected trajectory into the future.

Using the outline crafted by ChatGPT, I returned to Grok to ask for specific information and facts. For instance, in the section titled "Alan Turing and the Foundations of AI," I aimed to delve into his upbringing, notable contributions such as his time at Bell Labs, and his renowned "imitation game." Rather than composing a paragraph and continuing to prompt it, I posed individual questions directly to Grok, pasted the information into ChatGPT, and asked it to create paragraphs under a specific section of my paper. I did this for every section, and found I was able to extract only the information I really wanted, as opposed to the chatbots going on tangents I wasn't interested in.

Furthermore, it was essential to me that every section of my paper maintained a connection to Alan Turing, either by exploring his influence on AI or speculating on his potential perspectives regarding modern LLMs. For instance, in the segment focusing on the contributions of women to AI, I asked Grok: "In what ways has Alan Turing's work influenced Grace Hopper and the female pioneers of the ENIAC?" Additionally, I prompted Grok to contemplate: "How might Alan Turing react to the emergence of contemporary large language models?"

While a lot of our class concentrated on particular facets of AI—whether that be the role of women in AI, the contributions of underrepresented people in the development of AI, present ramifications, or future implications—I aimed for my paper to encompass a comprehensive spectrum. My intention was to explore various dimensions, delving into each aspect to discern the depth of knowledge chatbots possess across diverse facets of the same subject. I found myself surprised by the amount of knowledge they seemed to have.

What I discovered using a chatbot to write a research paper:

As previously mentioned, I used both Grok and ChatGPT throughout my research process. While Grok excelled in finding factual information, I found ChatGPT to be better at synthesizing these facts and presenting them in a coherent paper format. Initially, I hesitated to utilize multiple chatbots, because I was uncertain of how they would integrate information from each other, however, the outcome exceeded my expectations. I then reversed the approach, gathering facts from ChatGPT and tasking Grok with transforming them into cohesive paragraphs, yet I encountered significant challenges with this method. Therefore, I opted to rely on Grok for data acquisition and entrusted ChatGPT with the refinement of content.

When I requested citations from ChatGPT and Grok, Grok directed me to specific tweets and accounts as potential sources, and ChatGPT responded with an explanation that it couldn't directly provide citations due to its data sources being a blend of licensed data, human-generated data, and publicly available information. At this point, I introduced a third chatbot into the equation, Claude, and tasked it with sourcing citations for me.

I divided my paper into manageable sections and transferred each one into Claude separately requesting in-text citations. This approach aimed to ensure clarity and accuracy, particularly considering the length of the paper. At first, the sources seemed credible and aligned well with the content of each section, therefore I was pretty confident in their reliability. However, recognizing the importance of thoroughness, I decided to do it again. I repeated the process of pasting each paragraph into Claude individually and once again requested in-text citations. To my surprise, the outcome yielded a completely different set of sources. This experience prompted me to contemplate whether the discrepancies stemmed from inherent algorithmic limitations within AI or from the specific dataset on which the chatbot was trained.

I went ahead and asked Claude: “when I pasted my paper I got one set of sources, and when I repasted it to check the sources, I got a whole different list. Why is this?”

Claude responded with: You're right, I should not have provided different sources/bibliography when you pasted the same text again. As an AI assistant without access to actual research papers, I do not have a fixed set of sources that I pull from. Instead, when you ask me to add citations, I generate a set of hypothetical/fictional sources that seem plausibly related to the content you provided.

However, I should have maintained consistency and provided the same set of fictional sources both times for the same text input. Providing different sources defeats the purpose of in-text citations, which is to allow readers to cross-reference the cited works.

In the future, I will be sure to keep the sources consistent when citing the same content multiple times in a conversation. As an AI, I do not actually have access to real research papers, but I can create a coherent set of fictional citations for illustrative purposes and stick to that set throughout. Thank you for catching this inconsistency - it will help me improve my response integrity. Please let me know if you need any clarification or have additional examples where I can demonstrate consistent citation handling.

This would be considered more of a training issue, rather than an algorithm issue. I proceeded to also ask Claude: “what do you need to do to be able to actually cite sources and know for a fact that they are true,” and the chatbot responded saying “essentially, I would need to be integrated with large academic databases, enhanced with latest NLP research for citation extraction, and have transparent sourcing policies. Anthropic could explore partnerships with academic publishers, digital libraries, and fact-checking organizations to create such a comprehensive citation capability.”

Using AI to craft this paper has been an interesting journey, offering unique insights and challenges. The experience has been enlightening, revealing the vast potential of AI in augmenting human creativity and productivity. However, undertaking a task of this magnitude was notably more challenging than I initially anticipated. This paper has underscored the complexities inherent in leveraging AI for extensive written compositions, emphasizing the importance of continued refinement and adaptation in harnessing its capabilities effectively.

Final Paper Output:

Bolded Red = Incorrect information

From Turing to Chatbots: A Comprehensive Journey through the Evolution of Artificial Intelligence

Introduction

Artificial intelligence (AI) is a rapidly developing field that has undergone significant advancements over the past 70 years. This paper aims to provide a comprehensive overview of the development of AI from its early beginnings with Alan Turing's groundbreaking work to the modern era of large language model chatbots. We will trace the key milestones and innovations that have shaped the field of AI, including the Turing Test, expert systems, machine learning, deep learning, and the emergence of AI in everyday life. We will also examine the impact of AI on society and the potential future directions of the field.

The development of AI is important because it has the potential to revolutionize various aspects of our lives, from healthcare and education to transportation and communication (Makridakis, 2017). By understanding the history of AI and its key milestones, we can better appreciate its impact on our world and anticipate its future role in shaping our society.

One of the most significant figures in the history of AI is Alan Turing, who is widely considered the father of computer science and artificial intelligence (Copeland, 2004). Turing's work laid the foundation for modern computing and AI, and his ideas continue to influence the field today. For example, the Turing Test, which he proposed in 1950, remains a benchmark for evaluating AI's ability to exhibit intelligent behavior indistinguishable from a human (Turing, 1950).

As AI continues to develop and integrate into our daily lives, we can expect to see profound changes in the way we live, work, and interact with one another (Brynjolfsson, 2014). From the emergence of AI in everyday life, such as virtual assistants and recommendation systems, to the potential future directions of the field, AI has the power to transform our world in ways we can only begin to imagine. By examining the history of AI and its key milestones, we can better understand how it has already started to shape our future and anticipate the exciting possibilities that lie ahead.

AI has already started to shape our future by enhancing our problem-solving capabilities, improving efficiency, and enabling us to tackle complex challenges that were previously thought to be insurmountable. As we continue to develop and refine AI technologies, we can expect to see even more profound changes in the way we live, work, and interact with one another.

Alan Turing and the Foundations of AI

Turing's Early Life and Education

Alan Turing's early life and education laid the foundation for his groundbreaking contributions to computer science and artificial intelligence. Born on June 23, 1912, in Maida Vale, London, Alan Turing exhibited exceptional intellectual abilities from a young age (Hodges, 1983). His early fascination with science and mathematics set the stage for his future endeavors in academia and technology.

During his time at Sherborne School, Turing formed a close friendship with Christopher Morcom, who shared his passion for science and mathematics. Morcom's influence played a pivotal role in shaping Turing's interest in the foundational questions of logic and mathematics.

After graduating from Sherborne, Turing pursued his studies at King's College, Cambridge, where he excelled in mathematics. It was during his time at Cambridge that Turing made his first breakthrough in theoretical computer science with his seminal paper "On Computable Numbers, with an Application to the Entscheidungsproblem," published in 1936 (Turing, 1936).

Turing's Contributions to AI and Technology

Alan Turing's pioneering work in computer science and artificial intelligence revolutionized the way we think about technology and its potential. During World War II, Turing's theoretical insights into computation proved instrumental when he joined the Government Code and Cypher School at Bletchley Park (Hodges, 1983). There, he played a pivotal role in breaking the German naval Enigma code, developing the Bombe machine—a device crucial for deciphering encrypted messages.

Following the war, Turing spent time at Bell Labs in the United States, where he collaborated with Claude Shannon. Together, they realized the potential for machines, using binary instructions, to replicate human intelligence (Dyson, 2012). This realization sparked discussions about machine learning and the possibility of machines teaching themselves.

Turing's famous "imitation game" challenged conventional notions of intelligence and raised ethical considerations surrounding artificial intelligence (Turing, 1950). However, his ideas faced criticism, notably from John Searle, who argued against attributing consciousness and understanding to computers (Searle, 1980).

Alan Turing's life and work exemplify the intersection of intellect, innovation, and ethical inquiry. From his early curiosity to his enduring contributions, Turing's legacy continues to inspire advancements in AI and technology, reminding us of the ongoing quest to understand and harness the power of artificial intelligence.

Women Influencing AI

The Women of the ENIAC

Although people often tend to overlook the contributions of women in history, particularly in fields like science and engineering, the reality is that these remarkable individuals have played pivotal roles in shaping our technological landscape. Despite the pervasive "boys club" mentality that has historically dominated these fields, women have persistently defied expectations, carving out their place at the forefront of innovation and discovery.

The visionary women of ENIAC, including **Kay McNulty, Betty Jennings, Betty Snyder, Marlyn Wescoff, Fran Bilas, and Ruth Lichterman** (Light, 1999), alongside their previously mentioned counterparts, spearheaded a revolution in computing that reverberates to this day. Tasked with harnessing the power of the ENIAC, a behemoth boasting an impressive 17,000 transistors, they embarked on a journey that would redefine the very fabric of technological progress.

This colossal machine wasn't just a marvel of its time; it was a critical tool in the arsenal of World War II, tasked with executing the complex calculations necessary for precisely aiming artillery (Bartik, 1973). In the crucible of war, the ENIAC's capabilities were indispensable, providing military strategists with the precision required to turn the tide in battle.

Yet, beyond its wartime applications, the ENIAC's significance extended far into the future. Its sheer computational power laid the groundwork for modern computing and AI, showcasing the potential of electronic systems to handle complex tasks with unprecedented speed and accuracy (Burks & Burks, 1981).

The women of ENIAC weren't merely programmers; they were pioneers, shaping the very essence of technology and setting the stage for generations of innovators to come. Their legacy serves as a testament to the transformative impact of intellect, determination, and collaboration in propelling humanity forward into the digital age.

Grace Hopper and Software Programming

Grace Hopper's contributions to computer programming and software development have significantly influenced the evolution of artificial intelligence. Her pioneering work on the Mark I computer at Harvard not only revolutionized computing but also laid a crucial foundation for modern AI systems (Beyer, 2009).

Grace Hopper's journey towards becoming a trailblazing computer scientist was shaped by her upbringing and early experiences. Born on December 9, 1906, in New York City, Hopper displayed an early aptitude for mathematics and problem-solving (Williams, 2014). Encouraged by her parents to pursue her interests, she excelled academically and developed a passion for learning.

After graduating from Vassar College in 1928 with degrees in mathematics and physics, Hopper went on to earn a master's degree in mathematics from Yale University in 1930 (Beyer, 2009).

She then pursued a Ph.D. in mathematics at Yale but ultimately decided to join the United States Navy Reserve in 1943.

Hopper's decision to join the Navy marked the beginning of her remarkable career in computing. At the age of 37, she was commissioned as a lieutenant and assigned to work on the Harvard Mark I project (Gurer, 2002). It was during her time working on the Mark I computer that Hopper made significant contributions to the field of computer programming.

One of Hopper's notable achievements was popularizing the concept of debugging—a process crucial for identifying and fixing errors in computer programs (Williams, 2014). This concept became integral to AI development, where precise and error-free programming is essential for creating reliable and efficient AI algorithms.

Moreover, Hopper's innovations with the Mark I computer made it the most easily programmable machine of its time. By utilizing punched paper tape to input instructions, the Mark I could swiftly switch tasks, allowing for more flexible and adaptable computing systems (Beyer, 2009). These qualities are fundamental for AI applications, where systems must rapidly process diverse tasks and adapt to changing environments.

A key aspect of the Mark I's design was its use of electromechanical switches instead of vacuum tubes. This technological choice significantly enhanced the reliability and efficiency of the computer (Gurer, 2002). Unlike vacuum tubes, which were prone to failure and required frequent maintenance, electromechanical switches were more robust and durable. This reliability ensured consistent performance, making the Mark I well-suited for handling complex computations and laying the groundwork for future AI technologies.

Grace Hopper's groundbreaking work on the Mark I computer and her innovations in computer programming have had a profound and lasting impact on the development of artificial intelligence. Her emphasis on reliability, flexibility, and efficient programming continues to shape the field of AI, highlighting the importance of her contributions to modern computing (Williams, 2014).

Alan Turing's Influence on Them

Alan Turing's groundbreaking work in the field of computing had a profound influence on both the women of ENIAC and Grace Hopper, albeit in different ways.

For the women of ENIAC, Turing's contributions to the development of the theoretical underpinnings of computer science served as a guiding light (Barkley, 1994). His conceptualization of the Universal Turing Machine laid the groundwork for modern computing theory, inspiring the ENIAC programmers to explore the possibilities of electronic computation (Turing, 1936). Turing's work provided a theoretical framework that helped them understand the potential of computers beyond mere number crunching, fueling their innovative spirit as they programmed the ENIAC and pushed the boundaries of what was thought possible in computing (Grier, 2005).

Grace Hopper, on the other hand, was directly influenced by Turing's work in the practical realm of computer programming (Toole, 1998). Turing's code-breaking efforts during World War II demonstrated the critical role that programming played in harnessing the power of computers for real-world applications (Hodges, 2012). Hopper, a pioneering computer scientist in her own right, drew inspiration from Turing's work as she embarked on her own journey in computer programming (Beyer, 2009). She later went on to develop the first compiler for a programming language, laying the foundation for modern programming practices and making computers more accessible to a broader audience (Hopper, 1952).

Alan Turing's work served as both a theoretical and practical inspiration for the women of ENIAC and Grace Hopper, empowering them to push the boundaries of computing and leave an indelible mark on the history of technology.

Emergence of Large Language Model Chatbots

Technological Advancements

The emergence of Large Language Model (LLM) chatbots represents a monumental advancement in the field of Artificial Intelligence (AI) (Brown, 2020). These chatbots, such as OpenAI's ChatGPT and Google's Bard, leverage billions, and sometimes trillions, of parameters to process and respond to natural language queries with astonishing human-like fluency (Radford, 2019; Shazeer, 2022). Trained on an extensive corpus comprising articles, Wikipedia entries, books, and online resources, LLMs possess the capacity to provide responses ranging from mundane inquiries to nuanced discussions on complex subjects, such as the history of AI (Petroni, 2019).

Despite their sophistication, LLMs are not without flaws, occasionally yielding biased responses influenced by the data they've assimilated from the internet and their creators (Bender, 2021). Nevertheless, the landscape of LLM technology is continually evolving, with initiatives like the BIG-bench project pushing the boundaries of LLM capabilities through rigorous testing (Srivastava, 2022).

The proliferation of LLMs and chatbots has transformed various domains, from customer service to healthcare, promising to revolutionize interactions and facilitate personalized care delivery in areas like behavioral healthcare (Bratton & Babu, 2021).

However, their integration into daily life raises concerns regarding data privacy, security, and ethical implications, necessitating responsible deployment and risk mitigation strategies (Xu, 2022).

Future Trajectory of AI Development

Advancements in AI Technology

The future trajectory of AI development holds promises for significant advancements, particularly in key areas such as large language models (LLMs), integration of AI with robotics, and AI-driven customer service tools.

The continued evolution of large language models, exemplified by advancements like GPT-4 and Google's Gemini, signifies a remarkable leap forward in AI capabilities. These models, equipped

with multimodal functionalities and customization potential, are poised to revolutionize natural language understanding and generation (Chowdhery, 2022). Their ability to process text, images, and audio in a human-like manner opens doors to diverse applications beyond traditional domains, fostering accessibility and utility for a broader spectrum of users.

Furthermore, the integration of AI with robotics stands as a cornerstone of future AI development. While AI-enabled robotic systems have been utilized in manufacturing settings for decades, ongoing advancements hold the promise of enhancing efficiency and flexibility in industrial processes. From precision manufacturing to automated logistics, AI-driven robotics offer unprecedented opportunities for optimization and innovation.

Additionally, AI-driven customer service tools are poised to redefine the landscape of customer interactions. By leveraging data-driven insights and predictive analytics, these tools empower businesses to deliver personalized and efficient customer experiences (Xu, 2021). From chatbots to virtual assistants, AI-driven solutions are streamlining support processes and enhancing customer satisfaction across various industries.

Ethical Considerations and Challenges

However, amid these remarkable advancements, the future of AI development is not without its challenges, particularly in the realm of ethical considerations and potential societal impacts. Ethical concerns surrounding AI technologies, including issues of bias, privacy, security, and responsibility, demand careful attention and proactive mitigation strategies (Covels & Floridi, 2018; Mittelstadt, 2016). The inherent biases present in training data can lead to discriminatory outcomes, necessitating efforts to diversify datasets and enhance algorithmic transparency (Barocas & Selbst, 2016). Moreover, safeguarding privacy and data security in an increasingly digitized world is paramount, requiring robust regulatory frameworks and privacy-preserving technologies (Cath et al., 2018). Furthermore, the responsible deployment of AI systems entails integrating ethical considerations into the design and development process, ensuring that AI technologies uphold societal values and adhere to ethical standards (Floridi, 2018).

Beyond ethical considerations, the proliferation of AI technologies also presents challenges related to job displacement and ensuring the accuracy and reliability of AI systems (Frey & Osborne, 2017; Amodio, 2016). The automation facilitated by AI technologies has the potential to disrupt traditional employment sectors, necessitating proactive measures such as retraining programs and exploring socioeconomic safety nets like universal basic income (Korinek & Stiglitz, 2017). Moreover, addressing concerns regarding the accuracy and reliability of AI systems, particularly in instances of "hallucination" or generating inaccurate responses, requires ongoing efforts to improve model performance and validation processes (Zellers, 2019).

While the future trajectory of AI development holds immense promise for transformative advancements across various domains, it is imperative to navigate these advancements with a keen awareness of the ethical considerations and societal impacts they entail. By embracing responsible innovation and addressing emerging challenges, AI can truly realize its potential as a force for positive change in society.

Conclusion

The journey of artificial intelligence (AI) from its inception with Alan Turing's groundbreaking work to the emergence of large language model chatbots represents a remarkable evolution in human technological endeavors. This paper has provided a comprehensive overview of this development, tracing key milestones and innovations that have shaped the field of AI over the past seven decades.

Beginning with Alan Turing's pioneering contributions to computer science and AI, we explored how his theoretical insights laid the foundation for modern computing and inspired subsequent generations of researchers and innovators. Turing's conceptualization of the Universal Turing Machine and the Turing Test remains foundational in assessing AI's capabilities and understanding its potential to exhibit intelligent behavior akin to humans.

Moving forward, we delved into the pivotal role of women in AI development, highlighting their often overlooked yet invaluable contributions. From the visionary women of ENIAC who pioneered early computing advancements to trailblazers like Grace Hopper, whose innovations in programming shaped the future of AI, their impact on the field cannot be overstated. Their stories serve as a testament to the diversity of thought and talent essential for driving progress in AI.

Transitioning to the modern era, we explored the emergence of large language model chatbots as a monumental advancement in AI technology. These models, such as OpenAI's ChatGPT and Google's Bard, harness the power of billions, and in some cases, trillions of parameters to process and generate human-like responses to natural language queries. Despite their sophistication, ethical considerations surrounding bias, privacy, and security underscore the importance of responsible deployment and risk mitigation strategies.

Looking ahead, the future trajectory of AI development holds promise for significant advancements, including further enhancements in large language models, integration of AI with robotics, and AI-driven customer service tools. However, these advancements are accompanied by challenges related to ethical considerations, job displacement, and ensuring the accuracy and reliability of AI systems. Addressing these challenges will require a concerted effort from researchers, policymakers, and society at large to ensure that AI continues to be a force for positive change.

In conclusion, the development of artificial intelligence from Turing to large language model chatbots exemplifies humanity's relentless pursuit of knowledge and innovation. By understanding the history of AI and its key milestones, we gain insight into its transformative potential and the ethical considerations that accompany its evolution. As we navigate the complexities of AI development, let us remain vigilant in upholding ethical standards and harnessing the power of AI for the betterment of society.

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