The Development Characteristics and Application Changes of Generative Artificial Intelligence Technology——Take ChatGPT as an Example

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Abstract: Generative artificial intelligence is a new tool based on deep learning technology that can autonomously create diverse content. Its core characteristics lie in creativity,learning ability, and diversity,while also combining flexibility with efficiency. Compared to previous AI technologies, generative AI exhibits significant features such as strong human-computer interaction and heavy reliance on corpora. This presents new challenges and issues in both technological development and risk control, urgently requiring a fresh understanding and grasp.The governance of generative AI is a crucial aspect for promoting the healthy development of the digital economy.In the face of exponentially growing applications of generative AI, it is necessary to focus on key governance areas and innovate governance tools within the existing regulatory framework, promoting the healthy and orderly development of industries under reasonable risk control.

1. Introduction

Generative artificial intelligence (Generative Artificial Intelligence) is a significant branch of the AI field, focusing on creating models capable of generating new content (such as text, images, audio, and video). Unlike traditional discriminative models, generative models learn from the distribution of data to generate new samples that are similar to but entirely different from the training data. In recent years, generative AI has made significant progress in various fields and shows broad application potential. As a key driving force for the next wave of technological revolution and industrial transformation, the development and application expansion of AI technology are accelerating. Recently, the explosive application of generative AI technologies like ChatGPT has opened up endless possibilities for the future development of the AI industry. At the same time, issues such as misinformation, academic ethics, and labor substitution have sparked global discussions. Generative AI is a novel production method that uses AI technology to automatically generate content.Leveraging breakthroughs in large models, massive computing power, and training methods, generative AI has achieved high-quality, efficient, and diverse content creation, becoming a crucial force in driving digital productivity transformation.

2. The Emergence and Transition of Generative Artificial Intelligence Technology

In 1956, John McCarthy (John·McCarthy) first coined the term "artificial intelligence." Nick Bostrom (Nick Bostrom), an AI expert, believes that we have achieved superintelligence when artificial intelligence outperforms human brains in almost all areas, including scientific creativity, general wisdom, and social skills. As technology advances and evolves, the definition of artificial intelligence continues to change. Today, many products previously classified as AI no longer fit under this category based on current technical standards. Instead, systems that analyze and

discover data patterns (machine learning-deep learning) are becoming the dominant form of AI. The development of artificial intelligence can be divided into three main categories. First is narrow artificial intelligence (ANI), also known as "weak AI," which excels at quickly finding relevant information from vast amounts of data and performing digital procedural actions. It has been widely adopted and applied in some public service sectors, generating significant social and economic benefits. Second is general artificial intelligence (AGI), also referred to as human-level or strong AI, which is capable of understanding and reasoning about its operational needs like a human, with the ability to speakRecognition, natural language processing, visual recognition, and other processing capabilities. Next is Super Artificial Intelligence (ASI), which already possesses human-like intelligence, autonomous decision-making, and deep learning abilities. It can partially replace human brain thinking functions and also perform industrial production and operations, generating intrinsic, prior, and verifiable knowledge products. Currently, it is experiencing rapid development and application.

Under the alternation of technology, general artificial intelligence technology continuously completes its emergence and transition.The development of AI technology not only drives innovation in technological applications through continuous iterations but also constantly initiates disruptive technological revolutions to open up new technological fields.For example, in November 2022, the U.S. artificial intelligence research laboratory OpenAI launched a natural language processing tool robot called ChatGPT.ChatGPT is one type of GenAI model application product. From a technical perspective, ChatGPT is a natural language processing tool robot based on large language models, with its core being the three letters GPT (Generative Pre-trained Transformer), which translates to "generative pre-trained transformer." It can generate high-quality natural language text through massive pre-training and adapt to various natural language processing tasks. Compared to existing intelligent robot products, it has seen a revolutionary improvement in intelligence. Not only can it train models by connecting to vast language libraries to simulate human natural dialogue, but it can also handle more complex linguistic work. The core issue of achieving technological upgrades in AI is the evolution of algorithms, where automatic feedback from algorithmic evolution manifests as "self-description, self-adjustment, and self-control."[1]The Transformer-based nature of GenAIAfter the model greatly enhanced the language understanding and text generation ability, "big data + massive parameters + large computing power" enabled it to have a huge information processing capacity, and finally achieved the success of computational power leap and technical iteration upgrade.

3. Humanization of Generative Artificial Intelligence

Philosopher of analysis Robert Brandon (Robert Brandom) points out that "which cluster of capabilities we rely on can, in principle, make artificial objects intelligent." [2]Artificial intelligence has developed deep learning capabilities and surpassed human thinking in breadth and intensity in certain fields. ChatGPT is essentially the latest application of generative AI technology, serving as an immediate response terminal for information. It uses Transformer neural network architecture to mimic human associative and attention mechanisms in semantic analysis and output, capable of processing various types of inputs and outputs such as text, images, and audio, significantly enhancing human ability to handle analytical problems. "The father of ChatGPT," Sam Altman (Sam Altman), notes that a new Moores Law may soon emerge, where the number of intelligences in the universe doubles every 18 months, continuously generating digital resources. At the same time, it employs new training methods and optimization techniques, improving model efficiency and stability, becoming a multimodal large model. "Artificial intelligence integrates logic and mechanics, information and matter, subject and object into an organic whole of human perception realization and expression" (Tu Liangchuan, 2023). [3] Generative and discriminative approaches form the dividing line between GenAI, "the most direct way humans think about ChatGPT is to anthropomorphize it.""(Lan Jiang, 2023) [4]. The underlying logic of ChatGPT is to mimic the human brain, presenting a human-like thinking state. Essentially, it is an algorithmic approach in cognitive linguistics that shapes a digital universal rationality

in the digital public sphere, completely replacing the assumption of the economic man. Neurons in the human brain receive information through dendrites, perform simple summation operations in the cell body, and finally output the results to the next neuron via axons. All artificial intelligence neural networks, including ChatGPT, are constructed similarly. OpenAI employs a training method called reinforcement learning from human feedback to train the ChatGPT model, optimizing it based on human feedback. It can execute any intellectual task in any field and environment like humans, with the ability for self-learning and self-improvement. This forms the core value proposition of software robots, where their internal algorithms, computing power, and data become dominant, driving the functional deep integration of data, algorithms, and computing power at the R&D level. [5]

ChatGPT has swept the globe since its debut, leaving people amazed not only for its ability to engage in coherent and profound conversations but also for the emergence of intelligent capabilities such as reasoning and thought chains. As large pre-trained AI models continue to evolve, AI-generated content (AIGC) algorithms innovate, and multimodal AI becomes increasingly mainstream, AIGC technologies like ChatGPT are accelerating as the latest direction in the AI field. This is driving AI into its next era of significant growth and prosperity, with major impacts on economic and social development.

4. Technical Logic and Operation Mechanism of ChatGPT

The growth of GenAI will follow a natural process, where organizations transition from early experiments to proactive layouts for specific purposes, ultimately achieving widespread application in business activities. The GenAI model is primarily divided into five operational stages—intelligent sensing, information storage, information transmission, information processing, and intelligent terminals—forming a closed loop of the information chain. Edge computing becomes the key to successfully realizing GenAI. ChatGPT Essentially, it represents a new digital ecosystem, embodying a novel "pre-training + fine-tuning" deep learning architecture. ChatGPT Model technology is based on proprietary "self-attention mechanism" (The Self-attention Mechanism), enabling advanced functionalities in natural language processing (NLP) tasks, which is considered a high-fidelity representation of "emotional intelligence plus IQ" (Ling Xiaoxiong, Wang Dingmin, Yuan Jian, 2023). ChatGPTs operational mechanism consists of four core steps: "intelligent subject, algorithm architecture, training data, and output expression" [7] . It uses massive amounts of natural language text data for pre-training, allowing machines to gain deeper understanding and processing capabilities, capable of simulating different languages and cultures, facilitating dialogue and communication across languages and cultures, as well as understanding and generating natural language[6]. ChatGPT It is grounded in the concept of "human-in-the-loop" (Human-In-The-Loop)The basic reinforcement learning training method is to label representative or confusing samples in the form of sampling and then feed them back to the model. The model adjusts itself according to the feedback, and changes the human-computer interaction mode through continuous iteration.

ChatGPT employs reinforcement learning with human feedback (RLHF) technology, which can generate personalized dialogue content based on human interests and needs. This helps people better access information and services. Through conversations with ChatGPT, individuals can more quickly obtain information, solve problems, enhance skills, and automate the handling of numerous repetitive tasks, thereby improving work efficiency and tool productivity. ChatGPT can produce expressive and coherent dialogue texts, applicable in areas such as knowledge Q&A and online education, accelerating the dissemination and learning of knowledge, disrupting traditional human-computer interaction models, and paving the way for general AI. At OpenAIs first developer conference in November 2023, OpenAI announced plans to build an AI platform around GPT, launching GPT Store and introducing the concept of GPTs. In February 2024, OpenAI released Sora, an extended video generation model application that uses the transformer architecture to produce specific content videos based on textual input from authors, effectively addressing the technical limitations of AI video tools like Runway Gen 2 and Pika, which could only produce

coherent content for a few seconds. It is evident that while ChatGPT merely simulates human cognitive abilities, Sora achieves a video simulation of the physical world. The continuous emergence of GenAI model applications is creating a new paradigm and vibrant vitality in AIecosystem.

5. Future Trends of AIGC in Industrial Application

(1) Multi-modal brings innovation to the blue ocean of applications

Multimodal AI refers to artificial intelligence capable of processing and understanding various types of information, such as text, images, audio, and video. This type of AI not only handles tasks involving a single data type but also establishes connections and integrates different data types, achieving a comprehensive and holistic understanding of multimodality. AI can perform correlation analysis on various types of data, providing support for solving complex problems.

In the early stages of multimodal technology development, different modalities of AI began to integrate, such as the combination of image recognition and natural language processing. Besides ImageBind bridging six modalities, most are still exploring the fusion of text and images, but progress is rapid. UniDiffuser: In addition to unidirectional text-to-image generation, it can also achieve various functions like question-answering from images, joint production of text and images, and unconditional image-text generation. OpenAI has developed many multimodal AI examples, such as DALL-E and CLIP, which can recognize objects in images while generating descriptive texts related to the images, or new images of relevant items guided by the text.

As multimodal technology advances, multimodal AI can achieve a higher degree of integration when understanding and processing different types of data. Algorithms and models can establish connections between various data types, extracting shared information across modalities. This enables AI to deeply understand and solve complex problems. In the future, the development of multimodal technology in many innovative fields will open up a blue ocean of innovative applications.

(2) Generative AI brings a more human-like way of interacting

From interacting with computers using keyboards and mice, to swiping screens on phones with fingers, and then to using wake words to interact with smart speakers, human-computer interaction has evolved from recognizing machine commands to understanding human actions and speech, increasingly aligning with human habits. The development of generative AI offers humanity its first opportunity to converse with machines in natural language, while machines have gained an unprecedented ability to understand human language through large models, potentially ushering in a new wave of interactive transformation. Just as previous interactions have brought about revolutionary changes from terminals to connections and various applications, generative AI is poised to reshape the industrial chain, value chain, and ecosystem.

Generative AIs technological breakthrough has significantly enhanced the understanding capabilities of large models. These models can better interpret human expressions and generate answers that align more closely with human values. The technology is now mature enough to be usable in many scenarios, even highly effective. As tech companies continue to invest in alignment work, the "hallucinations" of large models are being continuously reduced, making it possible for humans to communicate with machines entirely through natural language for the first time. This is also the simplest, most direct, and most effective way for humans to explore machine intelligence.

In this context, all APPs can be rewritten using generative AI and may generate native AI APP. On one hand, with the backend unchanged, the front-end interaction of current software can directly switch to natural language dialogue, enabling more apps to have intelligent conversational capabilities and offering users a brand-new experience. Many application software and hardware products are already upgrading in this direction. On the

other hand, what holds greater market potential in the future is native AI APP, such as a universal personal assistant that could answer various questions, offer advice, and even handle tasks like meeting scheduling, article writing, and artistic creation. "Machine generation + human brain filtering" will become an important method of human-machine collaboration in the foreseeable future.

6. Conclusion

Artificial intelligence is advancing at an unprecedented pace, with multimodal generative AI leading in this transformative field. Advanced multimodal AI architectures, combined with data fusion and cross-modal learning technologies, enable these models to process and generate complex data across multiple modalities. Their applications are extensive, ranging from autonomous vehicles to facial emotion detection, from speech recognition to sophisticated AI systems capable of generating text and images, ubiquitous everywhere. Generative AI represents a significant milestone in the development of artificial intelligence, boasting powerful creativity and innovation capabilities. However, achieving AGI still faces numerous challenges. Current models have limitations in understanding, adaptability, and data dependency; pursuing AGI requires new breakthroughs to overcome these weaknesses, enabling AI systems to learn, reason, and apply knowledge more broadly.

Despite numerous challenges, ongoing research and practical applications continue to propel multimodal artificial intelligence forward. Through continuous advancements in training methods, architecture optimization, and addressing ethical issues, we will witness more creative applications emerge in the real world. Multimodal AI is undoubtedly a significant driving force for future technological development, profoundly transforming every aspect of our lives and work, and deserves our ongoing attention and anticipation.

In short, generative AI is an important part of the field of artificial intelligence, bringing new opportunities and challenges to all walks of life through its unique creativity and learning ability. With continuous technological progress, generative AI will play an increasingly important role in the future society and economy.

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