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AI in the era of large language models: current state, applications, limitations, and future

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ABSTRACT

Have you noticed how Artificial Intelligence (AI) has suddenly shifted from sci-fi movies to our daily text messages? Today, tools like ChatGPT, DeepSeek, and Gemini allow us to chat, create, and solve problems as if talking to a knowledgeable friend. But what exactly are these Large Language Models (LLMs), and are they equivalent to AI? This article demystifies how AI has entered a new era of "Daily Conversation", guides you through its powerful applications and risks, and finally looks ahead to a future of AI. Are you ready to dance with AI? Let's find out what these super digital brains really are!

AI *versus* LLMs: are they the same?

In recent years, the most striking breakthrough in AI has been the rise of Large Language Models (LLMs). Because of their popularity, many people outside the tech world have started treating "AI" and "LLMs" as synonymous. Strictly speaking, this is not accurate.

The field of AI encompasses a vast range of technologies that most of us never actually see. However, for the ordinary user, equating AI with LLMs is not entirely wrong. The reality is that the AI tools most people interact with, such as ChatGPT, DeepSeek, and Gemini, are indeed built on AI technology. These models are capable of understanding and generating human language, handling tasks that range from complex conversation and creative writing to programming and even automated "AI for Science" research (Zhang *et al*., 2025).

At the heart of these models lies deep learning, specifically the Transformer architecture found in LLMs systems. By processing colossal datasets, e.g., spanning books, websites, and academic papers, they internalize the structural patterns of language. This allows them to "think" and express ideas in a way that feels remarkably human.

Some of the key players in Figure 1 you might encounter include ChatGPT (the all-rounder for chatting, drafting text, and answering questions), DeepSeek (a powerful model known for its advanced reasoning and coding capabilities), Gemini (a multimodal powerhouse designed to handle text, images, and video effortlessly), and Claude (built with a strong emphasis on AI safety and alignment with human ethics).

The current status of AI: intelligence driven by "daily conversation"

In the past, AI applications were primarily concentrated on specific tasks, such as routine facial recognition and speech-to-text, or industry-specific tasks like production scheduling optimization and big data interpretation. However, the widespread adoption of LLMs has ushered AI into a new phase of "conversation for intelligence" (Zamfirescu-Pereira *et al*., 2023).

Beyond executing single tasks, LLMs can now engage in multi-turn dialogue, reasoning, and creative work, much like a knowledgeable human assistant. Mainstream application scenarios and corresponding LLM tools are shown in Table 1.

The barrier to entry for AI has dropped to an all-time low. Users merely need to input text as they would in a search engine, or engage in multi-turn conversations as if talking to family or friends, to facilitate progress in their daily lives, studies, and work.

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Limitations of AI: LLMs are not "omnipotent"

Despite the astonishing capabilities demonstrated by AI, they remain constrained by their underlying databases and inherent model functional defects, leading to several critical issues (Das *et al.,* 2025), as shown in Figure 2, and are discussed below.

Hallucination: the models may generate information that sounds plausible but is completely incorrect, such as fabricating fake historical events and literature. Gemini even explicitly

Table 1. Mainstream applications and representative AI tools involving LLMs.

Domain	Application scenarios	Typical AI tools
Work and study	Automated report generation, academic writing assistance	ChatGPT, Notion AI
Programming and development	Code generation, debugging, optimization	GitHub Copilot, DeepSeek
Customer service and marketing	Intelligent customer support, AD copy generation	Intercom, Jasper AI
Professional fields	Medical literature analysis, contract review	Watson, Lexion

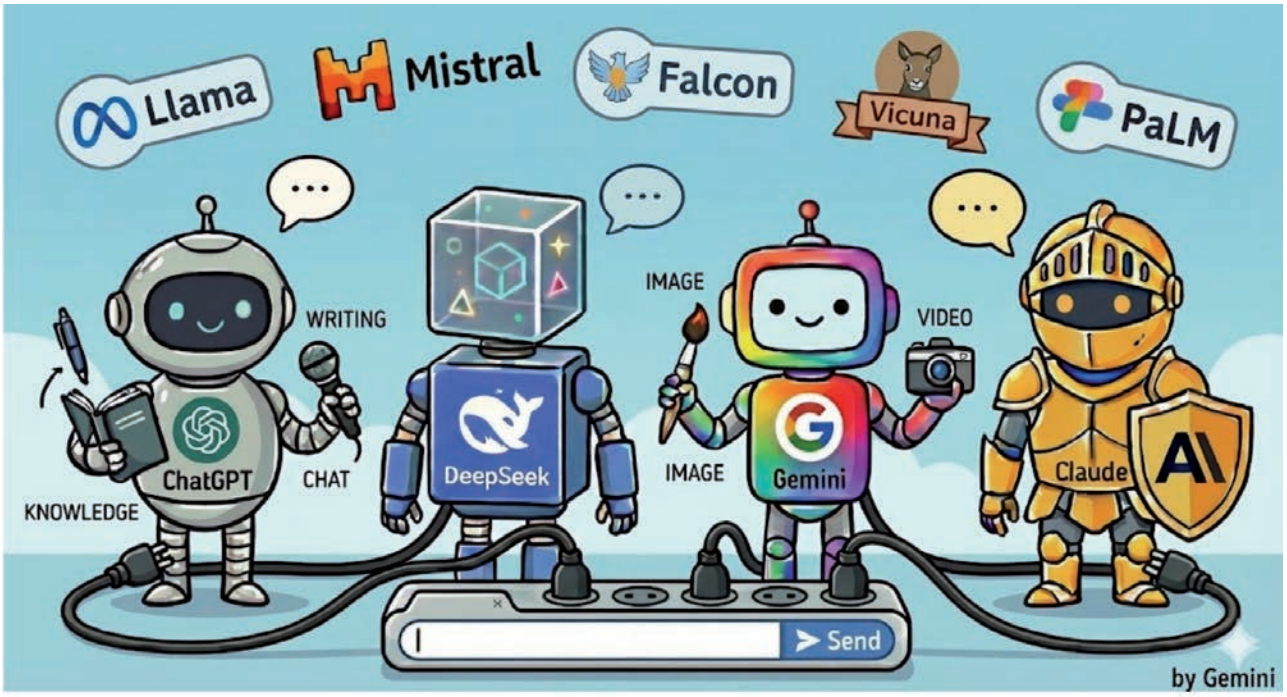

Figure 1. Mainstream LLMs and their capabilities. Image generated by the authors using Gemini AI.

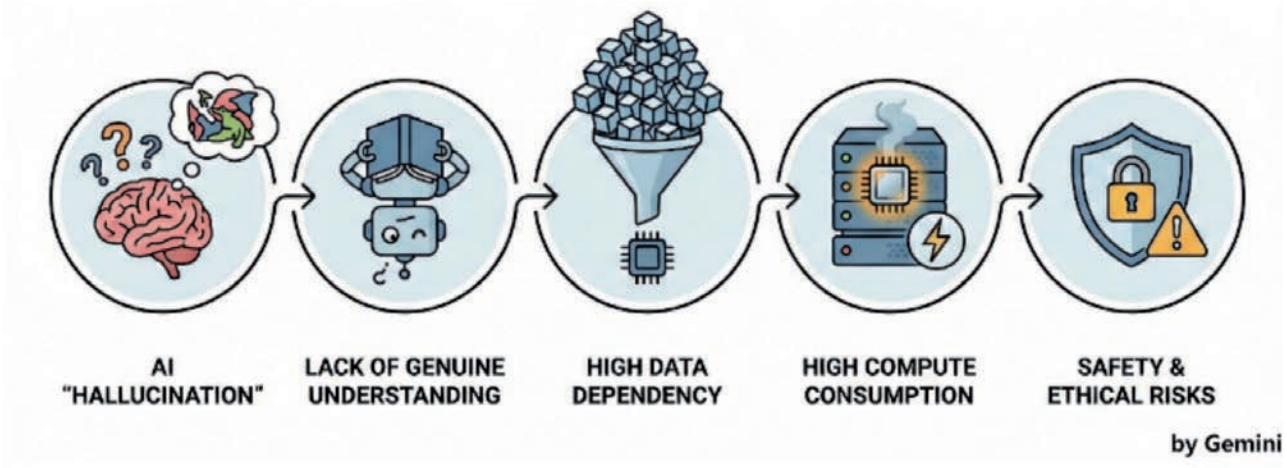

Figure 2. Limitations and risks of AI. Image generated by the authors using Gemini AI.

states "*Gemini can make mistakes, so double-check it*" below the dialog box in the interactive interface to remind users. ***Ways to respond:*** implement Retrieval-Augmented Generation (RAG) to connect the model to external, trusted knowledge bases, require citations for factual claims, and keep a "human-in-the-loop" for verification.

Lack of genuine understanding: although LLMs are capable of fluent dialogue, they do not truly "comprehend" the meaning behind the language. ***Ways to respond:*** use Chain-of-Thought (CoT) prompting to guide the model through logical reasoning steps to build complete, practical logic and understanding; combine LLMs with knowledge graphs to enforce structural logic.

Data dependency: biases present in training data may be inherited, e.g., gender or racial biases, which may cause LLMs to be more inclined to use "he" instead of "she", or to deeply associate gender with occupation, such as women and nurses. ***Ways to respond:*** for AI developers, it would be helpful to collect diverse and inclusive training datasets and utilize Reinforcement Learning from Human Feedback (RLHF) to align model outputs with ethical standards.

Resource consumption: running large models requires immense computing power, which is environmentally unfriendly and costly. ***Ways to respond:*** for AI developers, it is promising to develop Small Language Models (SLMs) optimized for efficiency, apply techniques like Model Quantization and Distillation to reduce parameter size, and utilize specialized, energy-efficient hardware. For ordinary users, wise model selection, precise interaction (prompting) design, and reduction of redundant requests can effectively reduce the collective carbon footprint of LLMs, so user habits may also play a key role in AI's environmental impact.

Safety and ethical risks: LLMs could be exploited to generate malicious content such as fake news or phishing emails. ***Ways to respond:*** for AI developers, deploying strict Input/Output Guardrails and content filters, conducting aggressive Red Teaming (security testing), and implementing Digital Watermarking to identify AI-generated content would be a feasible solution.

It is noteworthy that many of the above-mentioned issues are due to the technical architecture of AI and LLMs. Therefore, all ordinary users can do is to be more cautious and planned when using LLMs.

Future trends: how will LLMs change the world?

From the perspective of technical development, multimodal integration and lightweight on-device LLMs would be a trend. The future of AI lies not just in processing text, but in combining and **integrating multimodal data** such as images, speech, and video. **Lightweight models** are also promising as they can run directly on mobile phones and smart home devices, e.g., Apple's on-device AI, allowing them to more seamlessly integrate into every aspect of human life. Considering the increasing complexity of current models and potential crises of trust and ethics, **enhancing transparency** to enable users to understand its decision-making processes is also critical for the continued development of AI and LLMs.

The societal impact of AI is far-reaching, precipitating profound shifts across multiple domains. In the labor market, although AI threatens to displace or augment traditional roles in copywriting, customer service, and programming, it is simultaneously **spawning novel professions such as LLM trainers, ethical auditors, and prompt agents**. This transformative potential extends to education, where AI could serve as a powerful personalized **learning assistant**, provided that caution is exercised to prevent student overreliance. Consequently, to navigate these complexities and ensure the technology is not misused, governments worldwide are actively **drafting regulatory frameworks**, exemplified by the European Union AI Act (European Commission, 2021).

Conclusions: embrace AI, but remain objective and rational

LLMs mark a new phase in AI technology, reshaping the ways we work, learn, and live. However, they are not "superintelligence". They cannot yet function like a true human assistant, capable of comprehensively understanding specific, personalized human needs within context to make wise decisions. LLMs remain fundamentally powerful AI tools. How we use it, and use it well, depends on ourselves, or rather, on how users leverage language prompts to mobilize the AI's intelligent functions.

Some key recommendations for adopting AI would be of interest: leverage AI to enhance efficiency but maintain critical thinking and verify its outputs. Pay attention to AI ethics and support responsible technological development. Engage in continuous learning to adapt to the new opportunities of the AI era.

The future has arrived, are you ready to dance with AI?

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