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Technical Limitations of Artificial General Intelligence: A Systematic Literature Review

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Abstract

Artificial general intelligence (AGI) describes a form of artificial intelligence capable of handling diverse intellectual tasks with human-like adaptability and proficiency. Unlike narrow AI, which is built for specific functions, AGI stands out due to its ability to exercise sound judgment, adapt across domains, and manage a wide variety of challenges. As AI becomes more embedded in everyday life, achieving AGI represents a pivotal advancement in technology. Yet, significant theoretical and technical obstacles remain. This paper reviews existing literature to outline the primary hurdles in AGI research, including limited common sense reasoning, struggles with rare or unexpected scenarios, issues with generating inaccurate information, constrained memory, and weaknesses in reasoning, planning, and lifelong learning. The analysis suggests that progress may come from hybrid models, embodied cognitive approaches, and improved reasoning mechanisms. Improving generalization, computational scalability, robustness, explainability, verification, and safety will also be essential for developing reliable and adaptable AGI systems. Overall, the study presents a detailed examination of current technical barriers and helps shape future research directions in AGI development.

Keywords: Artificial General Intelligence (AGI); Common Sense Reasoning; Hybrid AI Systems; Embodied AI; Continual Learning; AI Safety.

1. Introduction

Artificial General Intelligence (AGI) represents the long-term objective of intelligence research: developing systems capable of understanding, learning, and performing a wide range of tasks similar to humans [1]. Unlike narrow AI, which is designed for specific functions, AGI aims to build adaptable systems that can generalize knowledge across domains, improve autonomously, and respond effectively to new situations [1], [2]. Advances in machine learning, particularly through Large Language Models, have enhanced AI capabilities in areas like language comprehension and visual recognition [1], [3]. However, existing systems still fall short in flexibility, reasoning, and sustained learning. They rely heavily on task-specific programming and struggle with generalization, logical inference, and retaining knowledge over time [1]–[3].

Despite significant progress, current AI technologies face persistent challenges such as hallucinations, limited reasoning abilities, and difficulty learning from experience—highlighting a clear gap between today's systems and true AGI [2], [3]. While numerous studies have explored various aspects of AGI, there remains a need for a thorough analysis of its technical barriers [1], [2]. This paper reviews the current state of AGI research, focusing on core issues including reasoning, learning, and safety. It synthesizes existing research to outline key obstacles and suggest directions for future work, aiming to support researchers in understanding both the present landscape and the path forward.

Achieving AGI would require systems that learn from experience, solve complex problems, and collaborate effectively with humans—capabilities that could transform fields like healthcare, education, and scientific discovery [1]. Yet, as these systems advance, concerns about safety, control, and ethical implications grow [2]. The ultimate aim of AGI research is not only to create intelligent machines but to ensure they are safe and beneficial to society [2]. This review provides a comprehensive look at the field's challenges and limitations, identifying critical areas for development. AGI remains a demanding but promising pursuit; with sustained effort, it may one day yield systems that significantly enhance how we live and work.

2. Literature Review

Artificial General Intelligence (AGI) seeks to equip artificial systems with the capacity to understand, learn, reason, and carry out a broad range of intellectual activities, rather than being confined to narrow, predefined tasks. Although recent progress in machine learning, deep learning, reinforcement learning, large language models, and foundation models has expanded AI capabilities, existing technologies still face fundamental shortcomings in reasoning, learning, memory, generalization, planning, and consistent performance in unfamiliar environments [1]–[3]. The following sections examine these limitations in detail.

2.1 Reasoning and Common-Sense Understanding

Reasoning is widely recognized in the literature as a major technical barrier to AGI. A key requirement for AGI is the ability to apply logical inference and derive conclusions from assumptions when no direct algorithm exists for solving a given problem [1], [2]. While modern AI systems excel in specific applications, they continue to struggle with abstract reasoning and coherent logical thought [1]–[3].

Common-sense understanding presents a similar hurdle. Although AI can store and process vast amounts of data, it lacks the intuitive grasp of everyday knowledge that humans possess [1], [2]. This deficit becomes particularly evident in new or ambiguous situations where reasoning based on real-world experience is necessary. As such, advancing common-sense reasoning remains a crucial step toward achieving general intelligence.

2.2 Generalization and Adaptability

The ability to generalize knowledge and adapt to new contexts is essential for any system aiming to function beyond its training environment. AGI, by definition, must operate across diverse domains, making this capability indispensable. However, current AI systems show significant weaknesses in this regard [1]–[3].

While specialized AI models perform well within their designated areas, they often fail when faced with novel scenarios outside their training scope [1]–[3]. Adaptability is closely tied to this issue—AGI must maintain reliable performance under varying conditions and respond effectively to previously unseen challenges, a requirement that today's systems are not yet equipped to meet.

2.3 Continual Learning and Memory

Learning and memory are foundational to intelligent behavior. The literature identifies continual learning as a core challenge: AI systems must accumulate new knowledge over time without losing previously acquired information [1], [3]. A related difficulty lies in the limited capacity of current systems to retain and organize knowledge, partly due to underdeveloped memory mechanisms [3]. For AGI, continuous learning is not optional—it should be an ongoing process. Therefore, developing robust memory architectures that support lifelong learning while integrating new data is a critical research goal.

2.4 Hallucination and Reliable Information

Hallucination—where AI systems generate false or fabricated information presented as fact—is identified in the literature as a serious limitation, especially in large language models [3]. Beyond hallucinations, broader concerns exist regarding the accuracy and trustworthiness of information processed and stored by AI. Overall, the reliability of AI-generated content remains constrained, posing a major obstacle to AGI development.

Since AGI must function accurately across multiple domains, factual consistency is essential. The combination of poor reasoning, unreliable outputs, and hallucinatory behavior undermines system performance [3]. Researchers emphasize the need for improved methods to verify training data and strengthen mechanisms that ensure trustworthy operation.

2.5 Planning and Decision-Making

Effective planning and decision-making are capabilities that current AI systems largely lack. True AGI should be capable of long-term planning and executing complex, multi-step tasks at a human level. The literature consistently points to deficiencies in reasoning, planning, and decision-making as central limitations [1], [2]. These functions are interdependent: sound decisions require strategic planning, which in turn depends on strong reasoning abilities [1], [2].

Long-term planning is especially problematic because systems often cannot make optimal choices in unfamiliar situations without predefined algorithms [1]. In such cases, success depends on drawing from existing knowledge and applying reasoned judgment—abilities that remain underdeveloped. Consequently, enhancing planning and decision-making remains a key priority.

2.6 Computational Scalability and Data Dependency

Computational scalability is cited as a major technical constraint. As AGI systems aim to integrate multiple cognitive functions, their complexity increases rapidly, demanding significantly greater computational resources to operate efficiently. Yet, current infrastructure struggles to support such demands, making scalability a pressing issue [1], [3].

Additionally, most AI systems rely heavily on large volumes of training data [1], [2]. While continuous improvement requires both data and processing power, this dependency limits flexibility and efficiency. Researchers stress the importance of reducing data requirements and optimizing computational efficiency to enable more scalable and autonomous systems.

2.7 Multimodal Perception and Model Integration

AGI systems must process information from multiple sources and modalities, such as text, vision, and audio, to interact effectively with complex environments. The literature underscores multimodal perception as a significant technical challenge [1], [3]. Successfully interpreting and integrating diverse types of input requires coordinated cognitive functions, which enhances performance but also increases system complexity.

Similarly, integrating different AI models poses difficulties, as most current systems rely on isolated architectures and limited algorithmic frameworks [1], [3]. Achieving AGI will require combining various approaches into unified, flexible systems. This integration challenge involves merging different methodologies to create solutions that are both versatile and reliable.

2.8 Explainability, Robustness, and Safety

Explainability—the ability of AI systems to clarify their decisions—is a growing concern. Current models often function as "black boxes," unable to provide clear justifications for their outputs [3]. This opacity reflects deeper issues in reasoning and reduces user trust. Without transparent decision processes, reliability and safety are compromised.

Robustness, or the ability to maintain performance under changing or unexpected conditions, is another key issue [2], [3]. Many AI systems exhibit unpredictable behaviors when exposed to unusual inputs, revealing their fragility. This lack of robustness directly affects safety, particularly in high-stakes applications where errors could endanger individuals or society [2], [3]. As a result, researchers advocate for systems designed with built-in safeguards and greater resilience.

2.9 Approaches Toward Technical Challenge Resolution

The literature outlines several strategies aimed at overcoming the challenges outlined above. Hybrid approaches, which combine different AI paradigms, are seen as particularly promising due to their potential to leverage complementary strengths [2], [3]. For instance, symbolic AI excels in structured reasoning and planning, though it lacks adaptability, while deep learning performs well in pattern recognition and perception tasks [2], [3]. Integrating these methods may help overcome limitations in generalization and flexibility. Other proposed directions include neuro-symbolic architectures, embodied cognition models, persistent memory systems, and advances in multimodal and reasoning capabilities [3]. The literature consistently emphasizes the need for progress across multiple fronts, suggesting that no single solution will suffice. Instead, a combination of innovations will likely be required to advance toward AGI.

2.10 Research Gap

The reviewed studies confirm substantial advancements in AI capabilities. Nevertheless, a significant gap remains between current systems and true AGI. Even the most advanced models described in the literature are typically effective only within narrowly defined domains.

Multiple technical barriers are identified across the literature, with recurring emphasis on shortcomings in planning, learning, and reasoning. Additional constraints involve adaptability, memory, information reliability, and decision-making. While each limitation is important on its own, their interconnected nature amplifies their collective impact. For example, continual learning depends on functional memory, and memory flaws can compromise data reliability, which in turn affects reasoning and planning. Such interdependencies suggest that isolated improvements may not lead to meaningful progress toward general intelligence.

This study aims to systematically analyze the current limitations of AGI and examine the solutions proposed in the literature. The following section will expand on these challenges and the research efforts directed at addressing them.

3. Methodology

This study adopts a systematic literature review approach to identify, categorize, and evaluate the technical challenges hindering the development of Artificial General Intelligence (AGI). The methodology is structured to ensure a rigorous process for searching, selecting, extracting data from, and synthesizing relevant research findings.

3.1. Research Design

The research follows a systematic review framework designed to pinpoint technical barriers in AGI development. It centers on examining constraints related to reasoning, learning, memory, planning, generalization, scalability, robustness, and safety in existing AI systems.

3.2. Research Objectives

The study seeks to map out key technical limitations in AGI development, assess their influence on progress toward general intelligence, review proposed technical solutions, and highlight unresolved issues that require further investigation to advance the field.

3.3. Literature Search and Data Collection

Relevant publications will be sourced from academic databases including IEEE Xplore, SpringerLink, ACM Digital Library, ScienceDirect, and Google Scholar, among other credible platforms. Key search terms include: Artificial General Intelligence, AGI, technical limitations, AGI challenges, reasoning, continual learning, generalization, memory, planning, hallucination, and AI safety. Only peer-reviewed articles, conference papers, journals, and technical reports focusing on AGI or its core technical capabilities will be considered.

3.4. Paper Selection

Papers will be selected based on their relevance to the study's objectives. Inclusion criteria emphasize contributions addressing AGI-related technical capabilities, limitations in current AI systems concerning general intelligence, architectural innovations, or technical strategies for overcoming these hurdles.

Excluded will be works primarily focused on non-technical dimensions—such as policy, ethics, governance, or philosophy—unless they contain direct references to technical challenges. Publications lacking relevance or sufficient detail will also be omitted.

3.5. Data Extraction and Classification

From the selected studies, data will be extracted using predefined technical categories derived from the research goals. Each paper will be assessed to identify specific technical limitations, their implications for AGI advancement, existing mitigation strategies, and remaining knowledge gaps.

Limitations will be grouped into categories such as reasoning and decision-making, common-sense understanding, hallucination, memory and knowledge representation, continual learning, generalization, planning, multimodal perception, computational scalability, model integration, robustness, explainability, and others. Each category will be analyzed in detail as outlined in Section 3.6.

3.6. Technical Analysis

Each included publication will be scrutinized to understand how the identified technical constraint affects AGI development. Particular attention will be given to whether current systems can support continuous learning, adapt to novel environments, reason effectively, retain information, and function reliably under uncertainty. The study will also assess technical proposals such as hybrid neuro-symbolic architectures, new reasoning models, embodied cognition frameworks, persistent memory systems, and other architectural innovations.

3.7. Comparative Analysis

A comparison of the identified limitations will be conducted based on their impact across various AGI capabilities. Factors such as learning efficiency, reasoning accuracy, generalization ability, memory retention, adaptability, robustness, scalability, explainability, and computational demands will be evaluated. This analysis aims to uncover recurring challenges and determine which aspects of general intelligence are most frequently addressed—or overlooked—in current research.

3.8. Synthesis of Findings

Findings will be synthesized thematically, with emphasis on recurring technical issues in areas like continual learning, reasoning, hallucination, and memory. Connections between these themes will be explored—for example, how catastrophic forgetting relates to long-term memory and continual learning, or how reasoning flaws may contribute to hallucinations and affect explainability.

3.9. Research Gap Identification

Based on the thematic synthesis in Section 3.8, this study will identify critical gaps in current research. Priority will be given to persistent technical challenges that remain inadequately addressed despite ongoing advancements in artificial intelligence.

3.10. Methodological Parameters

Key parameters guiding this review are summarized in Table 1 below.

Table 1. Summary of systematic literature review parameters

Parameter	Setting
Research Type	Systematic literature review
Primary topic	Technical limitations of AGI
Literature sources	IEEE Xplore, SpringerLink, Google Scholar, others
Publication type	Journal articles, conference papers, technical reports
Keywords	AGI, Artificial General Intelligence, technical limitations, reasoning, continual learning, generalization, memory, planning, hallucination, AI safety
Selection criteria	Relevance, technical contribution, academic quality, connection to AGI
Analysis framework	Thematic classification and comparative synthesis
Main output	Technical limitations, current approaches, and research gaps

3.11. Ethical and Safety Considerations

While the focus is on technical aspects, this study also acknowledges safety-critical issues tied to AGI. Therefore, it includes an assessment of technical factors affecting system safety, such as robustness, autonomous decision-making, verification mechanisms, security, alignment with human values, and risks arising from errors or loss of control in advanced intelligent systems.

3.12. Methodological Limitations

The scope of this review is constrained by the availability and consistency of published academic work. Variations in terminology, methods, and conceptual frameworks across studies may introduce some subjectivity in interpretation. Additionally, since AGI has not yet been realized, analyses rely on current theories of intelligence, partial demonstrations in existing systems, and projections about future capabilities—introducing inherent uncertainty.

3.13. Conclusion of the Methodology

The structured approach outlined above enables a comprehensive identification and evaluation of technical barriers to AGI. It supports an informed discussion of current solutions and provides a foundation for recognizing critical research gaps, ultimately contributing to a clearer understanding of the path forward in developing truly general intelligent systems.

4. Results

Developing artificial general intelligence (AGI) involves overcoming a range of technical challenges. An analysis of the selected literature identifies several recurring issues. Key limitations frequently cited include reasoning, learning, memory, generalization, computational scalability, robustness, and adaptability. These are summarized in Table 2, which outlines each technical barrier along with a concise explanation.

Table 2. Technical limitations of Artificial General Intelligence

Technical Limitation	Description
Reasoning and decision-making	Capacity for logical reasoning and making dependable decisions.
Hallucination	Generation of factually incorrect or fabricated information by AI systems.
Generalization	Ability to transfer knowledge to unfamiliar contexts or domains.
Continual learning	Capacity to acquire new knowledge over time without losing prior learning.
Memory	Ability to retain and retrieve long-term knowledge and experiences.
Planning	Capability to carry out long-term planning and operate autonomously.
Computational scalability	Growing demand for computing resources as AI systems become more complex.
Data dependency	Reliance on large volumes of data for effective training.
Multimodal perception	Skill in processing inputs from diverse sources using multiple cognitive functions.
Model integration	Ability to merge different AI models that use varied cognitive processes.
Explainability	Capacity to clearly explain the rationale behind AI-driven decisions.
Robustness and safety	Ability to function reliably, handle unexpected situations, and resist manipulation.

As shown in Table 2, reasoning and generalization emerge as central hurdles in AGI development. Effective reasoning is crucial for an AI system to perform well and adjust to novel environments. Scholars emphasize that while reasoning and decision-making are essential for a wide range of tasks, current AGI systems struggle with these functions, especially in domains that lack predefined solutions [1] [2].

Learning and memory also appear as critical yet constrained capabilities. The literature indicates that AGI systems face difficulties in continuously acquiring new knowledge while preserving it over time. Issues such as catastrophic forgetting—where new information overwrites old knowledge—static knowledge bases, and poor long-term memory retention significantly impair continual learning [1] [3].

Another major concern is the tendency of AI systems to produce hallucinations and their lack of mechanisms for explaining decisions. Studies point out that large language models often generate inaccurate content and cannot consistently justify their outputs [3]. This undermines their reliability in real-world applications where trustworthy reasoning is required.

Further challenges include computational scalability, dependence on large datasets, multimodal perception, and integrating multiple models. Scalability is a significant bottleneck, as AGI must draw insights from diverse sources to function effectively [1]. Continuous learning and cognitive improvement demand vast data and substantial computing power [3]. Moreover, enabling AI to interpret information across sensory or data modalities and to combine different models remains a complex task. Such systems would need to manage high levels of complexity, ensure compatibility between cognitive functions, and maintain consistent performance [1] [3].

Lastly, robustness, explainability, and safety are highlighted as critical issues. Many researchers observe that existing AI systems lack reliability, particularly when exposed to unfamiliar conditions [2] [3]. Their vulnerability to unpredictable behavior and external interference poses serious risks. Overall, the literature consistently identifies key technical barriers—such as reasoning, generalization, learning, memory, and hallucination—that must be addressed to advance AGI development.

5. Discussion

The findings of this review suggest that Artificial Intelligence remains distant from achieving the capabilities required for Artificial General Intelligence (AGI). Across the examined studies, modern AI systems consistently fall short of meeting the broad functional demands necessary to handle diverse tasks effectively [1], [2]. Despite these limitations, AI has demonstrated strong performance in specialized domains such as large language models, deep learning, reinforcement learning, and foundation models. These strengths, however, do not overcome the fundamental technical challenges that continue to hinder progress toward AGI.

One key limitation highlighted in the analysis is the underdeveloped capacity of AI systems in areas like common sense reasoning, general knowledge, comprehension, and logical inference. While current systems can process and store vast volumes of data and perform complex operations, they still rely heavily on task-specific input to function [1], [2]. This dependency reinforces the initial hypothesis that existing AI technologies lack robustness in reasoning and broad cognitive understanding [2], [3].

Learning represents another critical challenge. Although learning is central to AI development, current systems face significant constraints. A major issue is their reliance on large datasets—unlike humans, who can learn efficiently from minimal examples, AI typically requires extensive data to adapt and improve [1], [2]. Additionally, the phenomenon of catastrophic forgetting prevents AI models from integrating new information without overwriting previously acquired knowledge [1], [3]. Furthermore, the concept of static knowledge bases raises growing concerns. Current technologies struggle to maintain stable, rapidly accessible repositories of information that support continuous learning, limiting their long-term adaptability [3]. As a result, enabling sustained, dynamic learning in AI remains a pressing research goal.

Another important observation is the lack of universality among existing AI systems. No single approach currently meets the full range of requirements needed to address varied real-world problems. Symbolic AI performs well in rule-based environments and offers potential for verifiable reasoning, which could be vital for future AGI development [2], [3]. In contrast, deep learning excels in perception, pattern recognition, and handling unstructured data but continues to face difficulties in consistent reasoning and knowledge representation [2], [3]. However, recent trends indicate increasing interest in hybrid architectures—such as neuro-symbolic systems and language models with persistent memory [3]. The analysis supports this shift, suggesting that combining different paradigms may be essential to overcoming current barriers on the path to AGI.

Computational complexity also emerges as a major obstacle. Most AI systems demand substantial computing resources, which restricts scalability and practical deployment. Future AI will need to manage multiple data types, conduct multi-layered analysis, learn continuously, and coordinate various processes in parallel. Addressing these challenges is crucial, as their resolution would significantly advance the feasibility of AGI.

Closely tied to these technical issues are concerns about robustness, reliability, explainability, and safety. Present-day AI systems are often fragile and prone to errors, especially under unexpected conditions [2], [3]. Enhancing stable and transparent reasoning mechanisms is therefore essential for building trustworthy systems [3]. Moreover, ensuring system resilience and safety is vital for real-world applications. Current vulnerabilities, including susceptibility to generating or spreading misinformation, underscore the need for improved verification methods. Ultimately, future AI systems will need to combine high accuracy with dependable operation, secure knowledge management, and strong resistance to failure.

This study has several limitations worth noting. First, it is based solely on a literature review, meaning the conclusions reflect synthesized insights rather than original empirical findings. While the review incorporates numerous recent and past publications, the rapidly evolving nature of the field means some developments may not be fully represented. Second, the analysis is qualitative in nature. The absence of quantitative metrics does not undermine validity but reflects a different methodological approach. Third, as a review, it does not include experimental testing of hypotheses. Finally, inconsistencies in terminology and conceptual definitions across sources posed challenges during data interpretation, as similar ideas are often described using different terms.

In conclusion, the current state of AI reveals multiple unresolved challenges that must be addressed before AGI becomes achievable. Research efforts are actively focused on improving reasoning, knowledge validation, learning efficiency, and continuous adaptation. Yet, integrating these components into a cohesive, adaptable system remains an open problem. Advancing the ability to process unstructured data—a current weakness—is particularly important. Looking ahead, developing hybrid AI models tailored to specific contexts appears to be a promising direction, given that no single technology offers a universal solution.

6. Conclusion

Artificial General Intelligence (AGI) has long stood as a central aspiration within the field of artificial intelligence, representing the pursuit of systems capable of adapting and learning independently to handle a broad range of intellectual tasks. This systematic review has examined the key technical challenges currently preventing the realization of AGI. It identifies critical obstacles such as reasoning, common-sense comprehension, generalization, hallucination, continual learning, long-term memory, planning, scalability, robustness, explainability, and trustworthy autonomous decision-making—issues that must be resolved before AGI can become a reality. The findings suggest that, despite significant recent advances in AI, the path to achieving true general intelligence remains extensive.

The analysis indicates that future breakthroughs will likely depend on overcoming these challenges through a combination of innovative approaches. Promising directions include hybrid and neuro-symbolic models, multimodal learning, embodied cognition, and advancements in memory and reasoning systems. Special emphasis should be placed on improving scalability, ensuring system robustness, enabling effective verification, enhancing explainability, and maintaining control over intelligent behaviors. While many past limitations have been addressed, new complexities continue to emerge, demanding ongoing research and novel solutions. Future efforts should therefore focus on enabling AI systems to learn continuously, retain knowledge over time, and apply it effectively in unfamiliar contexts. Progress in reasoning, knowledge transfer, adaptive planning, and resilient learning architectures will be essential in moving closer to the goal of AGI.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability Statement

No original datasets were generated or analyzed in this study. The findings are based on a systematic review and synthesis of previously published literature obtained from publicly available academic sources. The publications used in the review are cited in the manuscript. Therefore, no separate dataset, repository, accession number, or DOI for a study-specific dataset is applicable. AI Usage Disclosure

AI Usage Disclosure

Generative AI tools were used solely for grammar refinement, structural formatting, paraphrasing, and sentence clarity enhancement during the drafting and preparation of the manuscript. All conceptual frameworks, feature definitions, methodological structures, and analytical conclusions were independently reviewed, verified, and finalized by the authors. The authors take full responsibility for the final content of the manuscript.

Author Contributions

[1]VaishnavyKU:
●**Credit Roles:** Writing—Original Draft (Sections: Abstract, Introduction, Literature Review)
● **Contributions:** Prepared the abstract, developed the introduction, and reviewed and synthesized relevant literature addressing the technical limitations and challenges of Artificial General Intelligence (AGI).

SajithaSanaP:
●**Credit Roles:** Methodology, Writing—Original Draft (Section: Methodology)
● **Contributions:** Developed and documented the systematic literature review methodology, including the research design, objectives, literature search and selection process, data extraction, classification, analysis framework, and methodological parameters.

DevikaPradhanP:
●**Credit Roles:** Writing—Original Draft (Section: Results)
● **Contributions:** Analyzed and organized the findings from the reviewed literature and prepared the Results section, including the classification and presentation of the major technical limitations affecting AGI development.

[4]NandhanaPradeep:
●**Credit Roles:** Writing—Original Draft (Section: Discussion)
● **Contributions:** Interpreted and discussed the identified technical challenges, including limitations in reasoning, learning, generalization, memory, computational complexity, robustness, explainability, and safety, and examined potential directions for future AGI development.

[5]**NiranjanaCS:**
●**Credit Roles:** Writing—Original Draft (Section: Conclusion)
● **Contributions:** Synthesized the major findings of the review and prepared the conclusion, highlighting the key technical barriers to AGI and promising directions for future research.

All authors have read and agreed to the published version of the manuscript.

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