A Comparative Evaluation of Neural-Symbolic Systems and Pure Neural Networks in Intelligent Decision-Making Frameworks

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Abstract. This paper explores the converging paths of neural-symbolic systems and pure neural networks within intelligent decision-making paradigms. As artificial intelligence continues to evolve, understanding the strengths and limitations of these competing approaches becomes imperative for advancing machine reasoning capabilities. Through a series of quantitative experiments and qualitative assessments, we analyze the performance of both methodologies across various real-world scenarios. Our findings reveal that while pure neural networks exhibit superior adaptability and data handling, neural-symbolic systems offer enhanced interpretability and logic-driven inference. This research contributes to a nuanced understanding of how these systems can be effectively integrated, paving the way for future developments in intelligent systems. The implications of this study extend to various applications, including automated reasoning and cognitive computing.

Keywords: neural-symbolic systems, artificial intelligence, intelligent decision-making, machine reasoning, pure neural networks, explainable AI, cognitive computing, logic-driven inference, data handling

Introduction

In recent years, the field of artificial intelligence (AI) has experienced exponential growth, driven by advancements in computational power and data availability. Within this expansive discipline, the intersection of neural networks and symbolic reasoning has gained significant attention, especially as the demand for explainable AI systems intensifies. Neural networks, known for their exceptional performance in tasks involving pattern recognition and classification, face challenges in the realms of interpretability and logical reasoning. Conversely, neural-symbolic systems attempt to bridge the gap between machine

learning and human-like reasoning, providing a framework which integrates the strengths of both paradigms. As we approach 2024, the relevance of this integration becomes increasingly critical. Organizations, policymakers, and researchers are calling for systems that not only demonstrate high performance but also maintain transparency and accountability. This paper aims to dissect the differences, advantages, and limitations of neural-symbolic systems compared to pure neural networks, placing a particular emphasis on their application in intelligent decision-making processes. Following this introduction, we will first outline the methodologies employed for our comparative analysis, detailing the experimental setups and evaluation criteria. We will then present the quantitative results, followed by a detailed discussion that situates our findings within the current landscape of artificial intelligence research. Finally, we will conclude with reflections on the implications of our study for future AI systems.

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