

1 Introduction

Reinforcement learning (RL) has been a rapidly growing area of research in recent years, driven by the success of deep learning techniques and the increasing complexity of tasks that artificial agents need to solve. Imagination-Augmented Reinforcement Learning (I2A) is an innovative approach that combines deep RL with an "imagination" component, enabling agents to predict upcoming observations and improve their decision-making capabilities. This approach has shown promising results in various environments, leading to more efficient and robust agents that can tackle a wider range of problems. In parallel, multi-agent deep reinforcement learning (MADRL) has emerged as a powerful paradigm for addressing complex, cooperative, and competitive tasks that require the interaction and coordination of multiple agents. MADRL extends the traditional single-agent RL framework by considering how multiple agents learn and adapt to each other's strategies, creating a more dynamic and challenging learning environment. This work aims to explore the potential of integrating Imagination-Augmented Reinforcement Learning with Multi-Agent Deep Reinforcement Learning, paving the way for a new generation of intelligent agents that can work together in complex, dynamic environments. We will begin by providing a brief overview of both I2A and MADRL, discussing their key concepts and recent advances. Next, we will delve into the challenges and opportunities that arise when combining these two frameworks, and outline potential research directions for the development of Imagination-Augmented Multi-Agent Deep Reinforcement Learning (I2A-MADRL). Finally, we will present some practical applications and real-world scenarios that could benefit from the advancements in I2A-MADRL, demonstrating the potential impact of this research on various industries and fields.