KBAI Fall 2024: ARC Project Milestone 1

Anonymous Submission

Abstract

The ARC Prize Challenge has been encouraging innovative solutions to complex reasoning tasks since a while. This paper presents an approach that can be used to tackle the ARC Prize Challenge using Knowledge-Based AI (KBAI) concepts and methods. My system integrates advanced reasoning techniques and knowledge representation frameworks to address the challenge's multifaceted problems. I describe the design and implementation of the approach that include KBAI topics and aims to build upon the resources available currently on the ARC prize challenge. Preliminary results and experiments section that will be filled as the project progresses will aim to demonstrate the effectiveness of my method, showing promise for high performance in the ARC Prize external evaluations. This work not only aims to contribute to the specific goals of the ARC Prize but also offers insights into the broader application of KBAI techniques i.e. generalizing the ideas presented.

Introduction

The quest for Artificial General Intelligence (AGI) is undoubtedly one of the most ambitious goals in the field of artificial intelligence. The ARC Prize Challenge stands as a prominent competition designed to push the boundaries of current AGI research by presenting participants with a series of complex reasoning tasks. This challenge is not only a test of AI capabilities but also an opportunity to explore and extend methodologies in Knowledge-Based AI (KBAI). The fact that this test has been around since 2019 first noticed in a paper written by François Chollet [[3]](https://arxiv.org/abs/1911.01547), the creator of Keras and researchers and scientists still aim to solve it and consider it a test of Intelligence speaks volume about the challenge and the numerous challenging ways it can be solved.

Knowledge-Based AI emphasizes the use of structured knowledge and reasoning processes to emulate human cognition, human-like understanding and decision-making. The ARC Prize Challenge provides a unique platform to apply these methodologies in a competitive setting, offering substantial rewards for high-performing solutions submitted by highly qualified students. This paper outlines our approach to addressing the challenge, focusing on leveraging KBAI principles to create a system capable of solving the challenge's problems with high accuracy.

Our approach involves several key components: advanced knowledge representation, efficient reasoning algorithms, and adaptive problem-solving strategies. We detail the design choices made to tailor our system for the ARC Prize tasks and discuss the integration of KBAI techniques that aim to enhance performance. By presenting our methodology and preliminary findings, we seek to contribute to the ongoing discourse on AGI and KBAI, offering both practical insights and theoretical advancements.

Various KBAI concepts taught in the class might come handy while attempting this project and some of them are – Pattern Matching and Unification, Search & Planning, Concepts and Concept-Learning. Before attempting the solution, as suggested, I completed 30 or so ARC challenges and it is exciting to see how a machine would aim to solve those and what are the thought processes it might go through. Below is a very simple demonstration of the task that is ARC prize challenge and what we are aiming to solve. On the left we have an image with 3 yellow filled squares, the task is to create the same image in a bigger grid with squares filled out in the places that the first image had and with the same pattern.

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**Related Work**

The field of Knowledge-Based AI has a rich history of research focused on enhancing machine intelligence through structured knowledge and reasoning. Recent advancements in KBAI have seen the integration of more sophisticated reasoning techniques, including probabilistic reasoning and cognitive modeling.

The ARC Prize Challenge builds on the foundations laid by previous work but introduces new dimensions by emphasizing diverse and intricate reasoning problems that require robust and adaptive solutions. Recent research has explored various approaches to similar problems, such as the use of neural-symbolic integration [[1]](https://arxiv.org/pdf/1905.06088) and hybrid AI systems that combine machine learning with symbolic reasoning [2]. These efforts highlight the ongoing evolution of methodologies aimed at bridging the gap between symbolic AI and data-driven approaches.

Our work contributes to this body of research by applying and extending KBAI techniques specifically tailored to the ARC Prize Challenge. By focusing on knowledge representation and reasoning strategies, we aim to advance the field and offer new insights into achieving high performance in AGI-related tasks.

Conclusion and Future Work

This section concludes the work completed during Milestone 1 which included an Abstract to give a brief idea about what this paper entails following by an Introduction section which formally introduced the paper and the ideas of ARC prize challenge and the KBAI methodologies. Finally, a related work section was added to show pre-work done before writing the paper and talking about some publications related to the ARC prize challenge.

References

1. Artur d’Avila Garcez, Marco Gori, Luis C. Lamb, Luciano Serafini, Michael Spranger, Son N. Tran. 2019, Neural-Symbolic Computing: An Effective Methodology for Principled Integration of Machine Learning and Reasoning. arxiv:1905.06088
2. Francois Chollet et al., 2019, On the Measure of Intelligence. arxiv:1911.01547

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