Leveraging Symbolic and Data-driven Methods for Object State Classification

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ABSTRACT

Traditionally, symbolic (high-level) and data-driven (low-level) approaches have been regarded as mutually exclusive methods for solving AI problems. However, a closer examination of the strengths and limitations of both approaches reveals that high-level and low-level methods are, to a significant extent, complementary. Despite their potential complementarity, integrating symbolic and data-driven components remains highly challenging due to factors such as differences in representation, the complexity of unifying knowledge, and the divergent optimization goals of each approach.

This work explores the development of a hybrid method that combines both high-level and low-level modules, specifically applied to Object State Classification (OSC), a Computer Vision (CV) task of significant theoretical and practical importance. While OSC is closely related to well-established CV problems like Action Recognition and Affordance Detection, it has only recently gained attention from the research community. This work investigates the problem across various settings, with a particular focus on the zero-shot variation of the OSC task, which is closely connected to other key learning problems beyond the realm of Computer Vision.

The proposed approach utilizes Knowledge Graphs (KGs) and Graph Neural Networks (GCNs) within an integrated pipeline. KGs efficiently represent diverse knowledge types, while GCNs enable effective processing of the knowledge encapsulated within the KGs. Compared to existing zero-shot models, our method demonstrates state-of-the-art (SoTA) performance, significantly outperforming competing approaches.