A Representational Format for Efficient Concept Learning and Relational Inference

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Abstract

A cornerstone of human intelligence is the ability to organize a vast number of entities into abstract concepts and to learn the complex, hierarchical relationships among them. Crucially, not all relations between concepts are directly experienced; many are inferred by integrating knowledge acquired about each concept independently. This capacity supports flexible integration and generalization of conceptual knowledge, yet its underlying computational principle remains unclear. Building on prior work on concept learning, we propose a representational format for concepts that supports efficient concept acquisition and relational inference. The model reproduces key human-like conceptual reasoning biases and, compared with artificial neural networks trained on the same concept structures, yields similar representational geometries yet with greater learning efficiency. These results provide initial evidence for an effective format of concept representation in high-dimensional space and how their relations are used and inferred.

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