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Relational reasoning and generalization using non-symbolic neural networks

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Abstract

Humans have a remarkable capacity to reason about abstract relational structures, an ability that may support some of the most impressive, human-unique cognitive feats. Equality (or identity) reasoning has been a key case study of abstract relational reasoning. This paper revisits the question of whether equality can be learned in non-symbolic neural networks. We find that simple neural networks are able to learn basic equality with relatively little training data. In a second case study, we show that sequential equality problems (learning ABA sequences) can be solved with only positive training instances. Finally, we consider a more complex, hierarchical equality problem, and find that this task can be solved with either a vast amount of training data or pre-training on basic equality. Overall, these findings indicate that neural models are able to solve equality-based reasoning tasks, suggesting that essential aspects of symbolic reasoning can emerge from data-driven, non-symbolic learning processes.