Representing Correlations in Conceptual Spaces

In artificial intelligence, one can distinguish two layers of knowledge representation: On the one hand, there is the symbolic layer, where abstract knowledge is represented in a structured, logic-based format. On the other hand, there is the subsymbolic layer, where perceptual knowledge is stored in a numeric way, e.g., in the form of weights within a neural network.

The highly influential framework of conceptual spaces proposes to an intermediate representational layer based on geometric representations: One can identify abstract symbols from the symbolic layer with regions in a high-dimensional space whose dimensions are based on subsymbolic perceptual processing.

In my talk, I will introduce my mathematical formalization of the conceptual spaces framework along with its implementation. This formalization aims to represent correlations between domains (such as “red apples are sweet and green apples are sour”) in a geometric way. I will illustrate that convex sets prevent such a geometric representation of correlations, whereas star-shaped sets do not. The proposed formalization includes not only a parametrically describable class of star-shaped sets, but also a large variety of operations on these sets.

Speaker Biography:
Lucas Bechberger is a PhD student and research associate at the Institute of Cognitive Science of the University of Osnabrück. With a background in computer science, machine learning, and artificial intelligence, his research is centered around the cognitive framework of conceptual spaces and the prospects of its use in artificial intelligence, mainly with respect to the symbol grounding problem.

Selected Publications:

- Lucas Bechberger and Kai-Uwe Kühnberger: “A Thorough Formalization of Conceptual Spaces” In: 40th German Conference on Artificial Intelligence, Dortmund/Germany, September 2017
- Lucas Bechberger and Kai-Uwe Kühnberger: “Measuring Relations Between Concepts in Conceptual Spaces” In: 37th SGAI International Conference on Artificial Intelligence, Cambridge/UK, December 2017
- Lucas Bechberger and Kai-Uwe Kühnberger: “Formalized Conceptual Spaces with a Geometric Representation of Correlations ” In: Mauri Kaipainen, Antti Hautamäki, Peter Gärdenfors, and Frank Zenker: “Concepts and their Applications”. Synthese Library. In press.