Computational Problem Solving in Spatial Substrates
A cognitive systems engineering approach

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Abstract.
The ability to solve spatial tasks is crucial for everyday life and thus of great importance for cognitive agents (humans, animals, robots). A common approach to modeling this ability in artificial intelligence has been to represent spatial configurations and spatial tasks in form of knowledge about space and time. Augmented by appropriate algorithms such representations allow the computation of knowledge-based solutions to spatial problems. In contrast, natural embodied and situated cognitive agents often solve spatial tasks without detailed knowledge about underlying geometric and mechanical laws and relationships; they can directly relate actions and their effects due to spatio-temporal affordances inherent in their bodies and their environments. Against this background, we argue that spatial and temporal structures in the body and the environment can substantially support (or even replace) reasoning effort in computational processes. I will demonstrate the approach with concrete examples.

Short bio.
Christian Freksa is Professor of Cognitive Systems at the Faculty of Mathematics and Informatics at the University of Bremen, Germany. His research concerns representation and reasoning with incomplete, imprecise, lean, coarse, approximate, fuzzy, and conflicting knowledge about physical environments. Particular emphasis is on qualitative spatial and temporal reasoning. Freksa received a PhD in Artificial Intelligence from UC Berkeley. He carried out research at the Max Planck Institute and at the Technical University of Munich, at the International Computer Science Institute in Berkeley, and at the University of Hamburg. In 2002 he initiated the International Spatial Cognition Quality Network and the Spatial Cognition Research Center in Bremen and Freiburg that he has been directing since 2003. Christian Freksa is a Fellow of the European AI society ECCAI.

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