Probabilistic Graphical Models in Complex Industrial Applications

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Abstract
In the last decade graphical models have become one of the most popular tools to structure uncertain knowledge about high-dimensional domains in order to make reasoning in such domains feasible. Their most prominent representatives are Bayesian networks and Markov networks, but also relational and possibilistic networks turned out to be useful in practical applications. For all types of networks several clear, correct, and efficient propagation methods have been developed, with join tree propagation and bucket elimination being among the most widely known.

In practice, however, the need also arises to support a variety of additional knowledge-based operations on graphical models, where revision, updating, the fusion of networks with relational rule systems, network approximation, and learning from data samples are some of the most important ones. Furthermore, it is essential to provide software tools in order to make interactive planning, reasoning, and decision making feasible, even in complex networks of real world applications. So lots of interesting research topics in this area have to be addressed.

The research to be reported about here was mainly triggered by consulting of the automobile manufacturer Daimler-Chrysler and Volkswagen Group, where graphical models are now established for several tasks. In opposite to many competitors, these two manufacturers favour a marketing policy that provides a maximum degree of freedom in choosing individual specifications of vehicles. That is, considering personal preferences, a customer may select from a large variety of options, each of which is taken from a so-called item family that characterizes a certain line of equipment. Typical examples include body variants, engines, gearshifts, door layouts, seat coverings, radios, and navigation systems. In case of the VW Golf there are about 200 families with typically 4 to 8 values each, and a total range of cardinalities from 2 up to 150. The presentation refers to new theoretical and algorithmic results on decomposable models as well as some details on industrial applications.

Biography
Rudolf Kruse obtained his diploma (Mathematics) degree in 1979 from University of Braunschweig, Germany, and a PhD in Mathematics in 1980 as well as the venia legendi in Mathematics in 1984 from the same university. Following a short stay at the Fraunhofer Gesellschaft, in 1986 he joined the University of Braunschweig as a professor of computer science. Since 1996 he is a full professor at the Department of Computer Science of the University of Magdeburg where he is leading the computational intelligence research group. He has carried out research and projects in statistics, artificial intelligence, expert systems, fuzzy control, fuzzy data analysis, computational intelligence, and data mining. His research group is very successful in various industrial applications, currently he is involved in industrial projects with BMW, British Telecom, Deutsche Sparkasse and Volkswagen in the area of intelligent data analysis. He has coauthored 12 monographs, 15 edited books, as well as 280 refereed technical papers in various scientific areas. He has been a plenary speaker to several utilities. He is associate editor of several scientific journals. Recently he became a fellow of the International Fuzzy Systems Association (IFSA), fellow of the European Coordinating Committee for Artificial Intelligence (ECCAI), and fellow of the Computational Intelligence Society (IEEE).