Perrier, Eric; **Imoto, Seiya**; **Miyano, Satoru**
Finding optimal Bayesian network given a super-structure. (English) Zbl 1225.68206
J. Mach. Learn. Res. 9, 2251-2286 (2008).

Summary: Classical approaches used to learn a Bayesian network structure from data have disadvantages in terms of complexity and lower accuracy of their results. However, a recent empirical study has shown that a hybrid algorithm improves sensitively accuracy and speed: it learns a skeleton with an independency test (IT) approach and constrains on the directed acyclic graphs (DAG) considered during the search-and-score phase. Subsequently, we theorize the structural constraint by introducing the concept of super-structure S, which is an undirected graph that restricts the search to networks whose skeleton is a subgraph of S. We develop a super-structure constrained optimal search (COS): its time complexity is upper bounded by $O(\gamma_m^n)$, where $\gamma_m < 2$ depends on the maximal degree m of S. Empirically, complexity depends on the average degree $\tilde{m}$ and sparse structures allow larger graphs to be calculated. Our algorithm is faster than an optimal search by several orders and even finds more accurate results when given a sound super-structure. Practically, S can be approximated by IT approaches; significance level of the tests controls its sparseness, enabling to control the trade-off between speed and accuracy. For incomplete super-structures, a greedily post-processed version (COS+) still enables to significantly outperform other heuristic searches.

MSC:

68T05 Learning and adaptive systems in artificial intelligence
62M45 Neural nets and related approaches to inference from stochastic processes

Keywords:

Bayesian networks; structure learning; optimal search; super-structure; connected subset

Software:

pcalg

Full Text: Link