

Optimal Expert Knowledge Elicitation for Bayesian Network Structure Identification

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Abstract: Bayesian network (BN) is a powerful framework for gaining mechanistic understanding of variables by revealing how the variables influence each other. However, for complex problems where the structure of a BN is unknown, a common approach is to learn the BN structure from observational data. A bottleneck of this approach is that observational data can only be used to discover part of the influential relationships among variables, resulting in a Markov equivalent ambiguity in the learned structures. To overcome this problem, we develop a Bayesian learning and sensing framework that can combine both observational data and expert elicitation data. Such a Bayesian learning framework will further lead to a systematic optimization formulation to optimize further elicitation of expert knowledge. To the best of our knowledge, our approach is the first of its kind that can automate the expert elicitation process and collect the most informative expert knowledge on top of the observational data, to learn the BN structure.

Bio: Dr. Shuai Huang is an Associate Professor at the Department of Industrial and Systems Engineering at the University of Washington. He received a B.S. degree on Statistics from the University of Science and Technology of China in 2007 and a Ph.D. degree on Industrial Engineering from the Arizona State University in 2012. He is also an adjunct faculty member at the Department of Biomedical Informatics and Medical Education (BIME) at the University of Washington. Dr. Huang's research interest is developing statistical learning and decision-making methods for healthcare problems. He develops methodologies for modeling, monitoring, diagnosis, and prognosis of complex networked systems such as the brain connectivity networks, social networks, manufacturing processes, and disease progression process of Type 1 diabetes and other diseases that have multiple stages and pathways. He also develops statistical and data mining models to integrate massive and heterogeneous datasets such as neuroimaging, genomics, proteomics, laboratory tests, demographics, and clinical variables, for facilitating scientific discoveries in biomedical research and better decision-makings in clinical practices. His research is funded by the National Science Foundation (NSF), National Institute of Health (NIH), Defense Advanced Research Projects Agency (DARPA), Air Force Office of Scientific Research (AFOSR), Army Research Lab (ARL), Juvenile Diabetes Research Foundation, Helmsley Foundation, and several biomedical research institutes. Dr. Huang currently serves as Associate Editor for the IIE Transactions in Healthcare Systems Engineering and Informatics Journal of Data Science.