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Editorial

Introduction to the special issue on Bayesian model views

Since its inauguration in 2003, the Bayesian Modeling Applications Workshop has become a recognized forum for interchange among those interested in applications of Bayesian modeling. The workshop provides an opportunity to share research questions, insights, experiences, methodologies and techniques. The workshop attracts theorists, practitioners and tool developers who apply Bayesian models to a wide range of domains. This special issue is devoted to papers from the fifth workshop in the series. The workshop theme was model views in Bayesian applications.

The term "model views" has many interpretations. In software and information systems engineering, it is often useful to make an explicit separation between the model and the user interface. Separation facilitates system maintenance and extensibility, because changes can be made to the model without affecting the user interface, and vice versa. Another reason to separate the model from the interface is that different categories of users may interact with the model in different ways. Examples include users with different degrees of technical sophistication, users having different access privileges, users in different geographic areas, and users who are responsible for different aspects of the problem domain. It is often desirable to tailor the user interface to these different categories of user. In many domains, there are common domain-specific communication patterns, such as maps, equipment diagrams, or standard tabular charts. In such cases, it may be desirable to provide model views based on these standard patterns. Finally, model views that are useful for building, testing and maintaining a model may be very different from the most appropriate views for end users.

This issue takes the theme in many directions. The papers by Almond and Portinale et al. describe interfaces that enable users to interact with a system in standard, accustomed ways, while capturing information that can be used to construct a Bayesian network model. Almond's work gives an elicitation strategy that allows users to take advantage of the sort of design-pattern repetition that occurs in his application: modeling a student's knowledge and the ways in which test questions and responses are evidential to that knowledge. Inputs from users are obtained through a familiar spreadsheet interface, and are transformed into Bayesian network fragments. Portinale et al. present a methodology and software tool for transforming dynamic fault trees (DFTs) into Bayesian networks. Their tool allows reliability engineers to interface with the system in accustomed and natural ways. The transformation into a Bayesian network allows computation of measures not directly computable from DFTs, and also opens the door to useful extensions of the DFT formalism (e.g., dependencies among failures; policies for correcting failures) that can be represented with dynamic Bayesian networks.

In a broader look at the model lifecycle, Tabachneck-Schijf and van der Gaag address the use of ontologies to support development and maintenance of multi-purpose libraries of model fragments. Ontologies provide a well-structured specification of elicited knowledge in an explicit yet understandable format, facilitating model maintenance and communication between knowledge engineers and experts. Most elicited knowledge is task-specific, they argue, and should be stored in task-specific modules. Laskey et al. also address the use of ontologies to facilitate model development, maintenance, and communication. They consider a concrete application, military use of geo-spatial information. In this domain, data come from varied sources, and are handled and used by different types of users with differing knowledge and requirements. Their focus is on the representation, analysis, and communication of uncertainty *about* the data: who needs to know what, and how will that information be communicated?

Other papers address the issue of multiple models or computational views. Jiang et al. consider the problem of possibly-incorrect data, and analyse the robustness of a particular methodology, BNetScan, with respect to statistically skewed data sets. Their application of interest is disease or infection outbreaks. Sharma et al. consider competing scientific theories. They ask how scientists, or their computers, can determine which theory is the best match to data that may be noisy or incomplete. Their application area is minerals exploration. Finally, Yi and Goldsmith's paper introduces multiple views to musical harmony. They use decision-theoretic planning to generate four-part harmony for a given melody line. They limit the generated harmony to specifying chords, but not how the notes of the chord will be distributed to the alto, tenor, and bass. They then assign the voicings stochastically, allowing one generated harmony to produce multiple "views" of the harmony.

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The range of applications presented here give a taste of the variety of applications of Bayesian reasoning. The papers show ingenuity and a solid basis for reasoning about Bayesian systems and their knowledge engineers, domain experts, and users. We hope that this journal issue will inspire more researchers to venture into the once-forbidding realm of Bayesian applications.

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