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Book Review

Bayesian Networks and Decision Graphs by Finn V. Jensen, Springer Verlag, £64.95, ISBN 0-387-95259-4

In the twelve or so years that I have been in the field, the topic of probabilistic reasoning has moved from being on the outskirts of artificial intelligence to being firmly in the mainstream. From a discipline that had to create its own forum[1] in order to get the fair hearing it was largely denied by mainstream events, it has become a discipline whose members have been honoured by the last two International Joint Conferences on Artificial Intelligence, and whose techniques are now considered to be a fundamental part of any course on artificial intelligence (by the writers of textbooks, at least). This transformation is due to the fact that Bayesian networks, and their close cousins influence diagrams, have proved to be both a natural representation of probabilistic information, and the basis for inference mechanisms which are suitably efficient in practice.

As one might expect, as the field has grown in influence and regard, a number of books have been published on the subject. There is Pearl's classic monograph (1988), which detailed his pioneering work, and Neapolitan's (1990), which was the first to gather together the various approaches to propagation "under one roof". More recently, Castillo *et al.* (1997) and Cowell *et al.* (1999) have published books which cover the full breadth of work on probabilistic reasoning, for instance dealing with topics such as decision-making and learning which were not covered in the earlier works. All of these books are (where available – sadly Neapolitan (1990) has been out of print for some time) more or less required reading for researchers in the area, and such researchers are well catered for. However, for many years there was no textbook which might be used as the basis for an undergraduate course or as a less technical introduction to the field.

This gap was admirably filled by Finn Jensen's previous book *An Introduction to Bayesian Networks* (1996), which I reviewed in volume **13**(2) of the *Knowledge Engineering Review* and which became a widely read and quoted volume. However, for whatever reason, the book was allowed to become out of print by the publishers, and for several years it has been hard to obtain a copy, and the gap yawned wide again. That this gap exists is not a criticism of the above-mentioned books. They are intended for postgraduate students and post-doctoral researchers, and serve that market very well. The problem is that to fully cover the theory behind Bayesian networks it is necessary to delve into a good deal of mathematics, much of which is beyond the scope of undergraduate courses on computer science. Thus it is questionable whether it is possible to write a book which might serve both as an introductory text and still provide enough technical detail to satisfy researchers in the field.

This question is not answered by *Bayesian Networks and Decision Graphs*, since I think that anyone who is really interested in the technical detail of propagation algorithms and the like will find they still have to consult other sources. However, this book does make an excellent introductory text. Indeed, in my view it is even better than *An Introduction to Bayeisan Networks*.

Given the high praise I sang of the earlier book in my review, how is this possible? Well, *Bayesian Networks and Decision Graphs* takes similar care to explain the basic concepts in a non-technical way, covering all the material (such as establishing the structure of a Bayesian network model and the necessary probability values) that are necessary to start using some of the many Bayesian network software packages that exist. The book then goes much further than its predecessor in covering topics such as adapting and tuning models, and in covering extensions of probabilistic models to full decision

[1] The Workshop, now Conference, on Uncertainty in Artificial Intelligence.

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theory in the form of decision trees and influence diagrams.[2] At this point the dilligent reader is rather like a typical car driver – capable of using the machinery in order to achieve all the things that they want to achieve with it, but with only a vague idea of what goes on under the bonnet.

Part II of the book is for those users who want to become mechanics. It does not give away all of the secrets, and in many ways (given the quantity of material published on the subject) barely scratches the surface. However, it gives a good, clear explanation of the fundamentals, covering the necessary graph theory and then algorithms for carrying out the usual operations in Bayesian networks and influence diagrams. This material is sufficient for many purposes, and is a good bridge between the more introductory material of the first part of the book and the more technical books mentioned above.

Overall, then, I think that *Bayesian Networks and Decision Graphs* is a very good book. Just like its predecessor it will be the book I recommend to new Ph.D. students, and if I get to teach another course on Bayesian networks, it will be the textbook I use. In fact the only complaint I have about the book is its price. Textbooks that cost £65 are never popular with students – maybe there is room in the catalogue for a paperback.

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[2] The only flaw in *An Introduction to Bayesian Networks* as an introductory text was the fact that it said relatively little about such models.

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