Prolog and Artificial Intelligence in Chemical Engineering

By T. E. Quantrille and Y. A. Liu, Academic Press, New York, 609 pp.

Among the programming languages used in the field of artificial intelligence (AI), LISP has been the language of choice in the United States, while Prolog has been used mostly in Europe. The book by Quantrille and Liu is the first to introduce Prolog and its artificial intelligence context to chemical engineers, and one of very few Prolog books that would be suitable for any engineers; the book thus represents a valuable addition to the literature. A clear advantage of Prolog is that it is easy to learn, even for people with little or no computer programming experience.

This book wisely begins with an introduction to programming with Prolog, rather than abstract AI concepts that might be difficult to grasp and of little use to the uninitiated reader. The pace of this 200-page part is quite relaxed, and a reader could learn Prolog through the detailed explanations of the book even without access to actual programming facilities; readers who practice Prolog programming as they study these chapters will find that they can adopt a quicker pace through this part.

The principles of AI are the second part of the book where the practical side of the concepts is illustrated with concrete examples, using Prolog. This part successfully captures and condenses the important and practical aspects of AI. The third part of the book is devoted to a case study from the authors' research, the EXSEP expert system for the synthesis of separations. This case study is very instructive. The context of the problem is stated in terms every chemical engineer can understand, and the AI concepts involved are shown in action, raising the reader's confidence about the value of AI for chemical engineering. The complete Prolog source code for this case study is included in the book. Finally, in its fourth part, the book focuses on the two most extensively used portions of AI; it provides an overview of chemical engineering applications of knowledge-based systems and an introduction to artificial neural networks. The discussion of the scope and potential of neural networks is refreshingly fair and balanced in assessing the role of this technology, its advantages, its limitations, and the best ways to go about investigating and applying the technology.

In all its chapters, particularly in the fourth part, the book includes a large number of references so that the reader may study particular applications or advanced topics in more detail. Another nice feature of the book is the provision of a glossary of AI and Prolog terms in an Appendix.

My only criticism of the book might be that it is somewhat long—over 600 large-size pages. The book's modular structure, however, makes it easy for readers to skim or skip sections, according to their backgrounds and needs. For example, the first three chapters (pages 1-86) cover basic aspects of Prolog which can be read and learned quickly by those readers who have extensive programming experience (especially if they have worked with expert system shells or LISP). The two chapters in Part IV (pages 396-487) reviewing knowledge-based applications and neural networks are self-standing and can be omitted or studied on their own. Finally, pages 488 to 609 consist of the index and Appendices, and approximately one half of this portion is the complete program listing for the EXSEP system for the synthesis of separations (pages 493-541). Thus, the length of the book is a result of the breadth of the material it covers and the inclusion of thorough reviews, explanations and documentation. The result of organizing this broad and thorough coverage in a modular fashion is a versatile book which can serve readers with different backgrounds and goals.

The authors obviously understand the subject matter very well. This well written book will be enjoyed by any chemical engineer that wants to become familiar with Prolog, the basic concepts of AI, and the full spectrum of AI applications in chemical engineering.

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Continuous Flow Methods In Organic Synthesis

By P. Tundo, Ellis Horwood Ltd., 310 pp., 3 Appendices, hardback, 1991.

This book is a comprehensive up-to-date survey of organic syntheses that are conducted by continuous-flow methods. The emphasis is on the production of fine chemicals, and the text is well-referenced (over 3,000 literature references). The presentation is a departure from the typical discussions of organic synthesis that normally involve batch processing. The book will be useful for researchers in such areas as polymer science, heterogeneous catalysis, and reaction engineering, because it covers reactions important to the production of polymers, pharmaceuticals and fine chemicals.

Chapter 1 involves the preparation and properties of heterogeneous and heterogenized catalysts. Emphasis is given to immobilization methods for gas-liquid (such as supported liquid-phase catalysis) and liquid-solid (such as metal complexes on inorganic and polymeric supports) reaction systems. (For a more exhaustive presentation of this topic, the reader is referred to *Supported Metal Complexes* by F. R. Hartley and D. Reidel, 1985).

Chapter 2 gives a brief overview of characterization methods used for studying heterogeneous catalysis. Techniques to measure physical properties (such as surface area, pore size and distribution) and chemical properties (such as chemisorption and photoemission) are discussed, but not covered in sufficient rigor for any real understanding. This, however, is not the main point of the book and does not detract from the following chapters.

Chapters 3, 4 and 5 provide an extremely nice survey of reactions carried out in the gas phase, in a gas phase over a liquid film, and in the liquid phase, respectively, using continuous-flow reactors. Chapter 3 contains well-documented sections on gas-phase reactions catalyzed by Nafion and zeolites and closes with a discussion of supported basic and superbasic catalysts. Chapter 4 mainly involves supported liquid-phase and phase transfer catalysis. Although a commercial supported liquid-phase catalyst does not exist as yet, the potential for future use in the synthesis of fine chemicals appears high. Chapter 5 describes continuous-flow systems for liquid-phase reactions using immobilized reagents (in solid-phase synthesis of peptides) and catalysts (strongly acidic ion exchange resins, supported aqueous-phase catalysts, phase transfer catalysts, and enzymes). The chapter includes an