human minds; that such a theory goes way beyond the evidence available, and can never be known with certainty to correspond exactly to the world. In a very real sense, had there never been any human beings, there would be no such thing as gravitational attraction. To emphasize this point, one could simply ask the question "The gravitational attraction that is supposed to be an intrinsic feature of the world—is this gravitational attraction as understood in Newtonian theory or is this gravitational attraction as understood in Einsteinian theory?" Of course, one feels that there is some force out there in the universe that attracts bits of matter to one another—and obviously there is—but the point I am making is that the nature of human cognition is such that there is no way of getting at an understanding of physical reality—in fact, there is no way of even talking about the world—that is independent of our theories. We can strive to improve our theories, but we cannot—in principle—achieve a theory-free account of the world.

Towards the end of Chapter 9, Searle claims to have shown that one of the main tenets of cognitivism—expressed by means of the sentence "The brain is a digital computer"—is not false but rather lacks a clear sense (225). Unfortunately for Searle exactly the same charge can be made—and for very similar reasons as I have shown—against his position: 'Syntax is not intrinsic to physics.' Although this sentence aspires to falsehood, it does not quite achieve it because Searle has failed to give it a clear sense. To reiterate: We can only single out features of the world by means of theories expressed in a language. Those features would not exist *for us* without a language and, thus, necessarily are observer-relative.

To conclude: I looked forward to reading the book because I agree with Popper that critical discussion and argumentation—especially between people with radically different outlooks—is crucial to the growth of knowledge, but I was disappointed because of Searle's slovenly and careless treatment of his own conceptual apparatus. Searle may well have important things to say about cognitive science, but I for one was so distracted and irritated by his discussion of the distinction between intrinsic and observer-relative properties that I have no reason to believe that the effort required to unearth them will be worthwhile.

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Artificial intelligence applications in manufacturing by A. F. Famili, D. S. Nau and S. H. Kim (Eds.), AAAI Press/MIT Press, 1992, pp 455, £35.95, ISBN 0-262-5606606.

The term "manufacturing" encompasses the broad range of activities involved in bringing a product to market. These range from marketing through design and development, planning of individual part manufacture, organization and control of manufacturing systems, and operation of production machines. In each of these fields there are well established computer applications involving modelling, simulation, analysis and control which come under the general headings of Computer-Aided Engineering (CAE), Computer-Aided Design and Manufacture (CADCAM) and Computer-Integrated Manufacture (CIM). In the past decade or so, the development of these applications has been constrained by limitations in traditional numerical approaches. The progress of automation has been restricted by the semantic weakness of representations used in modelling. Planning and scheduling problems have proved to be computationally complex, and susceptible to variations in the performance of real engineering systems. Incomplete and imprecise information have complicated decision making and analysis. In each of these areas solutions have been sought through the application of artificial intelligence.

The extent to which AI has penetrated manufacturing research is shown by the number of journals, conferences and workshops which have emerged in the field. The book under review is an outgrowth of such workshops organized by members of the special interest group Artificial Intelligence in Manufacturing, in particular at meetings convened at the International Joint Conference on Artificial intelligence (IJCAI-89), and the American Association for Artificial Intelligence (AAAI-90). The book is an edited collection of articles based on papers presented at, or motivated by, these workshops.

Although the title implies a general view of manufacturing applications of AI, the book has a strong bias towards planning and scheduling, and towards architectures for integration (the topics of the workshops). After a brief introduction and overview, it is divided into three parts, but these do not have separate introductory sections, nor do they contain overview or review articles.

The title of the first part, "Design and Planning", is rather misleading, for there is little discussion of design. Instead, the six articles concentrate on process and assembly planning—the identification of the sequences of operations required to manufacture and assemble an engineering product. The papers range widely from detailed discussion of reasoning with engineering part descriptions through application of machine learning in planning to more heuristic approaches in fixture design and operation planning. The computational detail of the approaches is most complete in this part, and the individual papers are each of interest to researchers in the area. However, one struggles to find an overview of the topics, and the papers are not a very representative cross-section of work in the domain.

Part 2 is entitled "Scheduling and Control", and the emphasis here is very much on the former. Production scheduling is closely linked to process planning in that it involves the scheduling of manufacturing operations for all the parts made by a manufacturing system. There are again six chapters, and these concentrate on scheduling using distributed, intelligent agents, on planning under uncertainty, and on reasoning, search and learning strategies. The papers form a coherent and readable collection, and the subject reviews are generally more comprehensive than in Part 1. Conversely, the detail in the articles is sometimes less complete.

The final six chapters form Part 3, which is devoted to "Manufacturing Integration". In this part the book returns to some of themes of Part 1, including the integration of manufacturing applications with product modelling using high-level abstractions known as features, and the building of process knowledge bases. The themes of intelligent agents and distributed problem solving also reappear, within the context of the integration of diverse applications. Once again, the implementational detail is sometimes a little sparse, but overview material is generally quite useful.

The editors note in their introductory remarks the relative lack of penetration of AI techniques into real engineering systems. It is my view that much of the value of work on AI in manufacturing to-date is not so much in the systems which have been delivered, but in the insights which are afforded into the manufacturing process, and in the techniques which are migrating into more mainstream CADCAM and CIM work. In this respect, the work is peppered with good insights and useful techniques.

The book is, however, an edited collection, and it therefore shares the strengths and weaknesses of the genre. It reflects very much the view of its author community. It does not cover the breadth of manufacturing applications of AI. Nor, as noted, does it introduce specific subjects well, because there are no overview sections, and the subject reviews in individual articles are sometimes weak. It is well produced in a consistent style and, usefully for an edited book, it does have an index, although this is little more than an index of words in section headings. It is not, therefore, a book for teachers or undergraduate students, nor indeed for practitioners at the applications end of industry (except perhaps to browse for the ideas and insights noted). But for the researcher in applications of AI in process planning, in production planning and scheduling, or in systems integration, there are a number of competent research papers, and the book is therefore well worth reading.

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Advances in cognitive science: Volume 2: theory and applications by G. Tiberghien (ed.), Ellis Horwood, Chichester, 1989, pp 206, £39.95, ISBN 0-7458-0532-9.

This book, from Ellis Horwood's series in cognitive science, claims to represent the state of cognitive science in France in 1989 (though some non-French work is included). It is a deliberate attempt to bridge the gap between the English-speaking and French-speaking cognitive science