Languages as a Cognitive Process Volume 1: Syntax Terry Winograd Stanford University

This textbook introduces a computational approach to the structure of human language. It presents a number of major linguistic theories within a cognitive computational framework. The fundamental ideas of computation are presented as they apply to language processing, and all of the prominent current approaches to syntax are explained within the framework (including transformational grammar, augmented transition networks, systemic grammar, case grammar, functional grammars and generalized phrase structure grammars.) The ideas are developed step-by-step, so students with no previous linguistic background can learn all of the relevant ideas through the text and exercises. There is also a survey of the existing computer systems for parsing natural language and an outline of English syntax.

The major theme of the book is that the structure of language can be best understood by seeing it as the result of a cognitive process' - a computational being carried out by a speaker/hearer of the language, making use of a body of stored knowledge about the language. This general perspective is used to integrate a wide variety of linguistic theories.

Contents

Viewing Language as a Knowledge-based Process●Word Pattern and Word Classes●Context-free Grammars and Parsing●Transformational Grammar● Augmented Transition Network Grammars●Feature and Function Grammars●Computer Systems for Natural Language Parsing●Appendices●Bibliography● Indices

Addison-Wesley Publishing Co.,Inc.
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Belief System Representations in Artificial Intelligence: A Validation Based on Linguistic Theories of Implicit Utterances Katharina Morik (In German)

This interdisciplinary study examines the influence of subjective knowledge on linguistic phenomena and presents criteria for validating Artificial Intelligence belief systems in terms of their ability to represent such knowledge.

Problems traditionally associated with the considerations of world knowledge within linguistic theory may be accounted for in part by the lack of suitable means of representing this knowledge. In order to use the concepts of techniques of knowledge representation offered by Artificial Intelligence for the scientific study of language and language use, it is necessary to show their validity.

Through the examination of implicit utterances, this work shows in which theoretical contexts world knowledge must be postulated and which properties are to be associated to it in order to handle phenomena such as presuppositions, coherency, and the recognition of indirect speech acts adequately. Subjectivity is pointed out as an essential characteristic of non-encyclopedic world knowledge. For further characterization of subjective world knowledge corresponding psychological studies are referred to. Thus, requirements for knowledge representation systems are drawn from the examination of linguistic phenomena, and in addition plausibility for these requirements is supported by consideration of psychological studies.

Artificial Intelligence representation of belief systems is comprehensively described as the conceptualization of subjective knowledge and evaluated accordingly. The evaluation criteria given poses a verification context that extends beyond Artificial Intelligence. Weaknesses of existing systems as well as the possibility of linguistic verification of belief systems can be demonstrated.

Tubingen: Niemeyer Verlag
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269 pp.

BOOK REVIEW

The Handbook of Artificial Intelligence Volume 2 A. Barr & E.A. Feigenbaum, eds. Volume 3 P.R. Cohen & E.A. Feigenbaum, eds.

Reviewed by:
Keith Price

The Handbook of Artificial Intelligence, Volumes 2 and 3, continue the work started in Volume 1 (see review in **SIGART #81, July 1982**). Volume 2 primarily covers applications oriented work (expert systems) with chapters on programming languages and automatic programming. Volume 3 contains a long chapter on vision and shorter chapters on learning, theorem proving, planning and models of cognition.

These 3 books are an attempt to review all areas of AI research and to provide a starting reference for researchers starting in AI and those already in the field. All survey books are dated by the time they are published and these are no exception. The bibliography is extensive, but there are few references after 1980. Volume 3 contains a complete index for all three volumes.

The first chapter of volume 2 (Chapter VI) reviews languages used in AI research. LISP, being the most important, is discussed in more detail than the others. This chapter (in contrast to the others) highlights the similarities and differences among the various languages (LISP, PLANNER, CONNIVER, SAIL, QLISP, POP-2, FUZZY, FOL, and PROLOG). The languages are compared in terms of available data structures, control structures, pattern matching provided by the language, and the overall programming environment.

Three chapters are devoted to applications oriented research (expert systems) - one each for scientific aids, medicine, and education. The first of these also provides a more general survey of expert systems including a section on TEIRESIAS which is designed to serve as the interactive component of an expert system. DENDRAL, being among the oldest and most developed, is covered in the most detail. Other programs discussed include CRYSALIS, PROSPECTOR, and MACSYMA plus three sections on other application areas. Notably absent is the recent work on aids for VLSI design, but this mostly reflects the time the chapter was written.

Coverage of AI systems in medicine is limited to consultation systems (MYCIN, CASNET, INTERNIST, IRIS, EXPERT, etc.) where the system is meant to be on aid to the physician. AI techniques in medical image analysis are not mentioned either here or in the chapter on vision in Volume 3. A parenthetical remark gives a reference for a subset of these applications. A major feature of the consultation systems is to remember all the details which a physician may forget so that the correct diagnosis is at least considered. As in most of the Handbook, the emphasis is on what is done rather than how. These systems are experimental so there cannot be a detailed evaluation of extensive clinical experience.

The third chapter on expert systems is applications in education. Education is very labor intensive and, to date, there are few means to increase productivity (increasing class size ultimately reduces learning and may have a net decrease in productivity). Computers are being used increasingly in education, but, too often, the computer is merely a fancy book. This chapter covers research intended to use the power available in the computer. (None of the sections discuss computer aided instruction for general AI. That may be an important topic in the future.)

Automatic programming (AP), the subject of the final chapter of Volume 2, is a constantly evolving field (it originally included the development of FORTRAN). The goals of AP are to translate natural descriptions of problems into an algorithmic form. But the examples presented are a long way from the generation of complex systems (an air traffic control system) given the basic description (guide planes from one airport to another without any collisions). The chapter failed to show what AP offers an experienced programmer that is not provided by an improved programmer environment such as provided by some LISP systems or SMALLTALK.

The first chapter of Volume 3 (Chapter XI) is on computer models of human cognition. There is a good overview of Newell and Simon's General Problem Solver. Opportunistic problem solving, EPAM and belief systems are also covered. The example used in the EPAM section fails to motivate the tests inserted in the discrimination net. This will make it hard for a novice to understand the ideas being used in EPAM. There is also a section on semantic network models of memory (Quilliam, HAM, ACT, and MEMOD). Cross references to other chapters in the three volumes are usually very thorough, but they were lacking in this chapter. For example, there is no reference back to the general discussion on production systems (III.C.4) in the discussion of ACT which is implemented as a production system.

Chapter XII is on theorem proving. There is some background information on logic and an introduction to the resolution rule. Some limitations of this method are discussed along with nonresolution theorem proving techniques. There are no reference to the AI programming languages chapter (VI) in the short section on logic programming.

The longest chapter (XIII, about 200 pages) is on computer vision. Since the handbook is only giving an overview of the basic ideas of each topic, the chapter is sufficient. The full range of topics in computer vision are discussed briefly, including blocks world, image level processing, representation, general algorithms, and large scale systems. It was interesting to see a discussion on vision without a single picture (except line drawings).

The next chapter (XIV) covers learning and inference. Of the four basic learning situations, by rote, from advice, from examples, and by analogy, results using only the first three are discussed. Rote learning is discussed in terms of Samuel's checker player, and taking advice in terms of the recent work of Mostow. The bulk of the chapter concerns the third type, using examples to learn simple or multiple concepts. There is a short section on classical pattern classification where the learning is through statistical analysis. This is a useful section since it reminds those in AI that there are other simpler ways to solve simple problems and provides a contrast to the AI techniques for newcomers to the field.

The final chapter (XI) is on problem solving. In some sense all AI research is problem solving; this chapter discusses the work which is concerned with techniques of problem solving or planning. Hierarchical and nonhierarchical planning are explained by using ABSTRIPS and STRIPS as representative planners. Other examples of each type are also given. The final example is the use of skeletal initial plans which provide an outline for the final sequence of operations.

The complete three volume set gives a good overview of AI and provides a good bibliography for further reading in all the subareas. These last two volumes contain more figures than the first which improves the presentation. The lack of good figures illustrates one of the problems in complete formatting of books, text, graphics, and pictures do not mix easily.

The Handbook tends to be very factual with few direct comparisons between systems and few subjective judgements. Most of the articles (as each subsection is called) describe the basic results and even some of the domain specific information required to understand what was accomplished. But there are too few cases where how something works is discussed in detail. A handbook should be more of a guide on how to perform a task rather than listing of the related tasks that have been solved. This does not mean that *The Handbook* is not important, it only means that there is another potential massive project for someone else - *The AI How-to Book.*

The Handbook provides a good guide to the field of AI both for novices and experienced researchers. Everyone should have one available for reference, especially for those areas outside your direct research area. I hope that these volumes are periodically revised, updated, and expanded so that they will provide an ongoing contribution to the field.