

J. KITTLER, Ed.

Pattern Recognition

4-th International Conference, Cambridge, U. K., March 28—30, 1988, Proceedings

Lecture Notes in Computer Science 301.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1988.

VII + 665 pages; DM 112,—.

This special volume of Lecture Notes in Computer Science contains papers presented at the BPRA 4th International Conference on Pattern Recognition held in Cambridge, 28—30 March 1988.

Papers are grouped along major themes which reflect all the major areas of contemporary research in the field of pattern recognition. Both the conventional "classical" topics like statistical and syntactic pattern recognition, classification techniques, image processing, applications in speech and text recognition, as well as newly developing areas like adaptive learning networks, computer vision and knowledge based methods are paid attention.

Contributions in Statistical Pattern Recognition section include the use of Markov random field models for image segmentation and the description of PREDITAS software package developed for solving a wide range of pattern recognition and diagnostic tasks. The Classification Techniques section includes papers on applications of measures of uncertainty in discriminant analysis, improving the discrimination of synthetic discriminant filters, a probabilistic learning system for ordered events OBSERVER, pattern classification in dynamical environments, application of a method of managing evidential reasoning to decision tree classifier. The Syntactic and Structural Methods section contains papers on approximate string matching, synthesis of attributed hypergraphs for knowledge representation of 3-D objects, reconstructible pairs of incomplete polyhedral drawings, and fractal curve and attribute grammar.

Several papers are devoted to problems of Image Segmentation: integrated image segmentation/image analysis system, automatic recognition of heat sources in satellite images, texture classification, range image segmentation and classification, enhanced linear model edge detector, processing poor quality line drawings by local estimation of noise, color classification algorithm for color images. A related section Image Restoration and Enhancement contains papers on fast and reliable image enhancement using fuzzy relaxation technique, the choice of regularisation parameter in image restoration, repeated averaging smoothing, and a color enhancement algorithm for remotely sensed false color images.

The Fuzzy Set and Pattern Theory section contains contributions on fuzzy set methods in pattern recognition, a fuzzy hybrid model for pattern classification, and the role of pattern in recognizer design.

New hot subject areas are represented by Adaptive Learning Networks containing papers on decision feedback in adaptive networks, dynamics of Hopfield associative memories, convergence in a learning network with pattern feedback, grey scale n -tuple processing and change detection in digital imagery using adaptive learning networks.

Another new area is represented by Knowledge-Based Methods, including papers on linguistic definition of generic models in computer vision, a multiple hypotheses rule-based automatic target recognizer, generic cueing in image understanding, knowledge-based approach for adaptive recognition of drawings, extended symbolic projections as a knowledge structure for spatial reasoning, and knowledge-based road network extraction on SPOT satellite images. Contributions on a biologically motivated approach to early visual computations, the first steps toward a black-

board controlled system for matching image and model in the presence of noise and distortion are grouped in the Computer Vision section, where as well the introductory tutorial paper *Is Vision a Pattern Recognition Problem?* belongs.

Several papers belong into the Special Hardware Architectures and Algorithms section, including a parallel architecture for model-based object recognition and a trainable image recognition system for the linear array processor LAPWING.

Two other sections are connected with the development of industrial robotics — namely the Shape Analysis, and the Motion and Depth Analysis. They include e.g. papers on methods of corner detection, the Hough transform in picture processing, recognizing infrared target images, linear algorithms for motion estimation, token-matching in real time motion analysis, determining 3-D structure of scene from image sequences.

Other important contributions connected with applications are included into the remaining sections on Speech Recognition, Speech and Text, Document Processing, and Applications. They include papers on statistical study in word recognition, a methodology for efficiency estimation of the speech signal feature extraction from line drawing images, syntax analysis in automated digitizing of maps, a fast binary template matching algorithm for document image data compression, a recognition system for three-view mechanical drawings, recognition of geological lineaments in remotely sensed imagery and the use of an assumption-based truth maintenance system to record and resolve ambiguity in cardiac angiograms.

The book not only provides a mere report on current activities in the field of pattern recognition and in related areas, but can serve also as a valuable source of inspiration for those engaged either in the theory or in applications of pattern recognition.

Pavel Pudil

M. A. VIERGEVER, A. TODD-POKROPEK, Eds.

Mathematics and Computer Science in Medical Imaging

NATO ASI Series — Series F: Computer and System Science, Vol. 39.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1988.

VIII + 546 pages; DM 178,—.

This book summarizes the proceedings of a NATO Advanced Study Institute on Mathematics and Computer Sciences in Medical Imaging, that was held in the mountains of Tuscany for 14 days in the summer of 1986.

Medical imaging is an important area in medical science. Many of the methods employed are essentially digital, and the subject has become increasingly influenced by developments in both mathematics and computer science. Mathematical problems have been the concern of a relatively small group of scientists, consisting mainly of applied mathematicians and theoretical physicists. Their efforts have led to workable algorithms for most imaging modalities. However, neither the fundamentals, nor the limitations and disadvantages of these algorithms are known to a sufficient degree to the physicists, engineers and physicians trying to implement these methods. This book tries to bridge this gap.

The book is well organized. It has been divided into two parts. The first part might serve as a textbook. This first part contains all the introductory and tutorial papers of eleven authors (Rescigno, Viergever, Koenderink, Barrett, Natterer, Appledorn, Todd-Pokropek, Herman, Fuchs, Fox and Walker), and should function as an overview of the subject matter of the meeting. The first part contains these topics: introduction to discrete reconstruction methods in medical imaging; image structure; fundamentals of the Radon transform; regularization techniques in medical imaging; statistical methods in pattern recognition; a survey of image data compression techniques; methods that have been developed to obtain three-dimensional

(3D) representations and rendering of medical objects based on a sequence of two-dimensional (2D) slices; review of some experimental and commercial graphics systems that intensively use very large scale integration (VLSI) technology; contribution to the interpretation of medical images based on the knowledge of shape structure, and object taxonomy.

The second part of this book contains papers of a more specialized nature divided into four sections: analytic reconstruction methods, iterative methods, display and evaluation, and a collection of papers grouped together under the heading of applications. The first section of the second part contains only two papers: one of them describes some mathematical properties of the attenuated Radon transform and line out numerical procedures using the conjugate gradient algorithm; in the second paper a method for mapping the scattering interaction density of a certain class of objects from a measurement of the scattering amplitude is developed for the case of a longitudinal acoustic or scalar electromagnetic wave scattering from an inhomogeneous medium consisting of wave velocity fluctuations. The second section contains papers dealing with: two criteria for choosing the number of iterations for Landweber's recursive algorithm applied to the inversion of an ill-posed linear equation: initial performance of block-iterative reconstruction algorithms; the expectation-maximization algorithm for maximum likelihood estimation applied to image reconstruction in positron emission tomography (PET) and time-of-flight assisted PET (TOFPET); maximum likelihood reconstruction for single photon emission computed tomography (SPECT) using Monte Carlo simulation; X-ray coded source tomosynthesis and some mathematical aspects of electrical impedance tomography. The third section contains papers in which hierarchical figure-based shape description for medical imaging, a generalized color model and its use for the representation of multiparameter medical images, the evaluation of image processing algorithms for use in medical imaging and a detection problem are presented.

In my opinion this book provide useful introductory and reference material suitable for physicists, engineers, computer scientists, mathematicians, and interested and informed clinicians working in the area of medical imaging.

Jana Novovičová

A. M. ODLYZKO, Ed.

Advances in Cryptology — CRYPTO '86

Proceedings

Lecture Notes in Computer Science 263.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1987.

XI + 489 pages; DM 60,50.

Since the year 1981 a series of annual conferences devoted to cryptologic research is organized at the University of California at Santa Barbara. With the exception of the first conference the proceedings of these conferences are published under the title *Advances in Cryptology*. The first two of them have appeared in the publishing house Plenum, the further in the Springer-Verlag. Under the same title also proceedings of some European conferences on cryptology were published. Both the series differ in the complementary part of their name, i.e. CRYPTO is used in case of American conferences and EUROCRYPT in case of European conferences.

The conference on the theory and applications of cryptographic techniques CRYPTO 86 with D. Coppersmith (IBM) at the head and sponsored by The International Association for Cryptologic Research in co-operation with the IEEE Computer Society Technical Committee on Security and Privacy was held from the 11th to the 15th August 1986.

The Proceedings include 36 contributions, 7 of which are presented in the form of extended abstracts. The papers are divided into 8 sections. The first section is devoted to the U.S. Data Encryption Standard and to problems connected with its application.

Section 2 (Public-Key Cryptography) studies some new methods of encryption: private-key algebraic coding (Rao and Nam), a pseudo-random bit generator based on elliptic logarithms (Kaliski, Jr.) or identity-based cryptosystem (Desmedt and Quisquater). Breaking of the Cade cipher is announced (James, Lidl and Niederreiter) and a modification of this broken public-key cipher is presented (Cade). Two papers deal with the digital signature scheme (de Jonge and Chaum; Goldreich) and a secure multi-party cryptographic protocol based on RSA is studied (Chaum and Evertse).

Section 3 (Cryptographic Protocols and Zero-Knowledge Proofs) discusses the zero-knowledge proofs and protocols in different domains (e.g. Boolean circuits, discrete logarithm or electronic poker). Some practical applications are given by Goldreich, Micali and Wigderson (powerful methodologies for developing two-party and multi-party cryptographic protocols), by Fiat and Shamir (simple identification and signature schemes suited for microprocessor-based devices such as smart cards, personal computers, and remote control systems) and by others.

Three papers in Section 4 are devoted to the secret-sharing methods. Implementations of some cryptographic algorithms are presented in Section 5 (Hardware Systems). They concern the RSA algorithm of a public-key cryptosystem (Orton, Roy and Scott; Barrett). Section 6 (Software Systems) includes two papers, one of them dealing with high speed manipulation detected code (Jueneman), the other one being devoted to the solution of special problems in electronic funds transfer point of sale in Australia (Gyoery and Seberry).

Section 7 (Software Protection, Probabilistic Methods, and Other Topics) treats a problem of authentication codes (Stinson), gives a sketch of the theory of software protection (Goldreich), shows the equivalence of the three well-known definitions of security for public-key cryptosystems (Micali, Rackoff and Sloan), etc.

In the last section (Informal Contributions) the Rabin's probabilistic primality test is discussed (Béauchein, Brassard, Crépeau and Goutier), a procedure for securely initializing cryptographic variables in a large number of network terminals is described (Matyas), and the possible use of cryptography in preventing hardware and software viruses is considered (Desmedt). Finally, the smart card is presented as a highly reliable and portable security device (Guillou and Ugon) and THOMAS — a complete single chip RSA device is introduced (Rankine).

As the reader can see, the Proceedings contain many new and interesting results and they are of interest for every specialist in cryptography.

Miloslav Driml

B. BENNINGHOFEN, S. KEMMERICH, M. M. RICHTER

Systems of Reductions

Lecture Notes in Computer Science 277.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1987.

X + 265 pages; DM 40,50.

The volume under review is devoted to systems of reductions that enjoy a growing popularity in computer science. To illustrate an activity in the corresponding field of symbolic evaluation, look over, for instance, the list of the notes of this series in the last years.

“A system of reductions is a set R of ordered pairs $\langle t, s \rangle$ of terms which are called reductions and will be denoted by $t \rightarrow s$. A term is ...”, of course, the definition of the system of reductions continues to introduce the basic concepts of the volume. Informally, the system of reductions is a system of equations (rewriting rules) which can only be applied from the left to the right side. As the referred volume is intended as self-contained, the definitions of the needed concepts of algebra, formal languages, and automata are recalled in Chapter I and much general material is added. The definition mentioned above opens Chapter II that is devoted to finite sets of reduc-

and I. V. Ramakrishnan present a parallel algorithm for tree pattern matching. An extension of equational formalism, term rewriting systems with priorities, investigate J. C. M. Basten, J. A. Bergstra and J. W. Klop, a mechanism, called the structured contextual system, is developed by Qian Zhenyu to deal with some non-finitely-based algebraic specifications. Algorithmic complexity of term rewriting systems is investigated by C. Choppy, S. Kaplan and M. Soria, the word problem and its decidability and complexity is considered by C. Squier and F. Otto and by F. Otto. The papers by M. Benois and by K. Madlener and F. Otto are devoted to certain classes of rewriting systems. Unification is studied by H. J. Bürkert, A. Herold, M. Schmidt-Schauss and by J. H. Gallier, W. Snyder, the papers by P. Réty and by P. Padawitz are dealing with narrowing techniques.

The published lecture and all contributions are of high scientific level and the volume should be recommended to computer science specialists interested in symbolic evaluation and related fields.

Jiří Pík

DOMINIQUE SNYERS, ANDRÉ THAYSE

From Logic Design to Logic Programming

Theorem Proving Techniques and P-Functions

Lecture Notes in Computer Science 271.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1987.

125 pages; DM 27,—.

With the subtitle "Theorem Proving and P-Functions", the book aims at the problem of the synthesis and computer implementation of algorithms. Algorithmic state machine of Glushkov serves as a theoretical model of synchronous sequential machines and the Karp and Miller model gives a framework for parallel program schemata.

Although the notion of P-function was originally developed for the design of computer algorithms in imperative programming languages and environment, the main purpose of the book under review is to show that P-functions can lead to a declarative type of programming via the theorem proving model. Chapter 1 gives a short introduction and abstracts of the remaining three ones. Chapter 2 shows that some operations acting on P-functions can be interpreted as elementary steps of a theorem proving procedure. It describes connection of algorithm synthesis to logic transformations and presents the language Prolog as a formalism for systolic architecture representation, simulation and proving. It shows how operational interpretation of logic programs can be separated into pure Boolean logic and a register transfer language that corresponds to unification.

Chapter 3 gives a short introduction to the use of P-functions and logic programs in natural language processing and speech understanding. It presents essentially an introduction to syntactic and to semantic analysis by means of the language Prolog. The last chapter shows how the semantics of a language can be represented. The formalism of attribute grammars is used and it is shown that P-functions can be related to attribute grammars. Then the formalism of the Definite Clause Grammars is presented as a special case of attribute grammars and the Definite Clause Translation Grammars are introduced as an extension of the definite clause grammar formalism. The use of logic for the semantic representation of natural language is illustrated by means of the Montague semantics.

The book under review presents in a uniform way theoretical framework and possible applications of P-function calculus to Logic Programming and two important branches of Artificial Intelligence with emphasis on the both sides of the implementation of algorithms: high-level description and logic design of hardware.

Petr Štěpánek

B. BOUCHON, R. R. YAGER, Eds.

Uncertainty in Knowledge-Based Systems

International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, Paris, France, June 30—July 4, 1986, Selected and Extended Contributions

Lecture Notes in Computer Science 286.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1987.

VIII + 450 pages; DM 55,—.

The International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, which was held in Paris in June/July 1986, was the first international conference on the subject of uncertainty in decision support systems. The core of the reviewed volume is formed by the papers presented at this conference. A number of complex problems is attacked, many of which have not been satisfactorily solved yet. From the very beginning of the volume (Section I Preliminary Papers) the reader can see almost the whole range of all main approaches used for formalization and representation of uncertain knowledge including probabilistic methods (H. E. Kyburg, Jr.), logical tools (R. R. Yager) and the fuzzy approach (B. Bouchon, S. Depres). The wide variety of tools is also reflected in organization of the main section of the volume with papers presenting new ideas in the field. This section entitled II: Approaches to Uncertainty is divided into four parts:

a) Evidence theory, b) Fuzzy set theory, c) Probability theory, d) General issues.

The first of them contains 6 papers related to the Dempster-Schafer theory of evidence in different ways. K. Mellouli, G. Shafer and P. Shenoy study a qualitative description of Markov networks based on the concept of qualitative independence. Issuing from new measures of specificity D. Dubois and H. Prade introduce the principle of minimum specificity which is similar, in a sense, to the maximum entropy principle. A Chateauneuf and J. Y. Jaffray weaken assumptions of the Dempster-Schafer theory to admit a wider class of input information. The remaining three papers by E. H. Ruspini, P. V. Fua and E. M. Oblow also contribute to generalization of the evidence theory and all of them are strictly based on probability theory.

On the contrary to the first part, the range of papers included into the second part (fuzzy set theory) is very wide. It contains six papers ranging from a methodological paper describing a proposal of knowledge modelling in fuzzy systems (J. Darzentas) to a detailed study of the generalized modus ponens rule usable in deduction systems (R. Martin-Clouaire). M. Frydenberg and S. I. Gallant are interested in an automatic generation of expert systems using the Matrix Controlled Inference Engine process while the next paper by J. Montero and J. Tejada is a contribution to the decision making theory with fuzzy preference relations. An interesting paper is also the one by M. De Glas which proposes an axiomatic definition of fuzzy information. This approach is based on representation of many-valued Lukasiewicz algebras. The last paper of this part is Z. Wang's contribution to some recent advances on the possibility measure theory.

Though the third part (Probability theory) with only three papers is the shortest one, it is no less important than the others. It only reflects the fact that in 1986 adherents of probabilistic methods in knowledge-based systems were not very numerous. The first from these papers by G. Steve is a critical view of PROSPECTOR-like systems showing that there are limitations which cannot be overcome in these "classical" systems. The second contribution (S. Shen) discusses a framework for assigning probabilities to rules in expert systems. The last paper in this part is unfortunately only an extended abstract of the J. Pearl's lecture Probabilistic reasoning using graphs. This contribution is a constructive proposal how to handle uncertainty in a way consistent with the probability theory.

As it can be guessed from the title, the last part of the second section (General Issues) consists of papers not fitting into the previous parts. Nevertheless, D. Driankov's paper, being an introduction of a new calculus for belief intervals, is an alternative approach to the Dempster-Shafer theory. Remaining papers range from strictly theoretical ones (e.g. M. E. Cohen, D. L. Hudson: Use of pattern classification in medical decision making) to a paper containing a description of algorithms for knowledge base organization (S. Frediani, L. Saitta).

Section III: Applications represents more than one fourth of the whole volume. Though we cannot pay detailed attention to the 10 contributions contained in this section most of them are not mere accounts of applications but bring also interesting theoretical ideas.

The volume is finished with a short section with four contributions on information theory. The papers by J. Aczel and Pl. Kannappan are surveys of sensible measures of information and their properties. The former is concluded with an extensive bibliography of the subject. The last two contributions (P. Gómel and R. Vallée) deal with unusual measures of information gain.

It is hardly possible to go into more details when reviewing a volume of this extent but we can emphasize that the editors, Drs. Bernadette Bouchon of France and Ronald Yager of the United States, were successful in representing the state of art in the field of uncertainty management in 1986. This fact is also appreciated in the L. A. Zadeh's foreword: "Their efforts have culminated in a truly international collection of papers which for the first time bring together highly authoritative analyses of the issues which are central to the conception and design of knowledge-based systems."

Radim Jiroušek

NICK CERCONE, GORDON McCALLA, Eds.

The Knowledge Frontier

Essays in the Representation of Knowledge

Symbolic Computation — Artificial Intelligence.

Springer-Verlag, New York—Berlin—Heidelberg—London—Paris—Tokyo 1987.

XXXV + 512 pages; 93 illustrations; DM 78,—.

The new volume of Springer Series on Symbolic Computation is devoted to the central topic of artificial intelligence, i.e. to the problem of knowledge representation. It contains 17 papers of 26 authors but editors of this volume successfully integrated the large variety of research into a well readable, informative collection. Just the title of the book indicates a broader context in which the representation problem is approached. The book arose from the earlier IEEE Computer Special issue Vol. 16, No. 10, October 1983 on Knowledge Representation edited by the present editors. Later most contributions except 4 were considerably enhanced when they were integrated into the volume under review.

The papers in the book are divided into the following six sections: 1. Overview, 2. Logic, 3. Foundations, 4. Organization, 5. Reasoning, and 6. Applications. We shall briefly characterize each of them.

The first section includes two papers. The first, entitled "What is knowledge representation?", by editors of this volume introduces a reader into major approaches to knowledge representation, namely to logical representations, semantic networks, procedural representations, frame-based representation, production systems architectures, and languages for knowledge representation. Authors describe both general principles of knowledge representation and fundamentals of each approach together with illustrative examples and comparisons among different approaches. The second paper of this introductory section, W. A. Wood's "Knowledge representation: What's important about it?" is a reflexion on requirements for knowledge representation schemas. Some examples are demonstrated within the knowledge representation language KL-One.

The author stresses expressivity and notational efficacy of a representational scheme, especially its computational and conceptual efficiency.

Logic section includes three papers dealing with relation of logic and knowledge representation that was widely discussed not only in knowledge engineering but also in the whole artificial intelligence. What role logic should play and what role it really plays in knowledge representation is the topic of D. Israel's paper with the title "Some remarks on the place of logic in knowledge representation". In this paper the author emphasises two roles of logic, namely its role as a representational formalism and its role in reasoning processes. In the context of logical reasoning he discusses non-traditional types of reasoning, especially non-monotonic ones. One of such types of reasoning, default logic, is discussed in the next paper by B. L. Weber entitled "Logic and natural language". In this paper default logic is shown as a suitable formalism for computing linguistic presuppositions. The author argues that "logic is our best tool for reasoning, and reasoning is needed in both analyzing and generating purposeful utterances". Thus he discusses the importance of modal logic for planning utterances and temporal logic for reasoning about future events. Eventually, the Logic section is ended with a detailed L. Zadeh's discussion on fuzzy logic and commonsense reasoning.

In the next section of Foundations the first of three papers discusses some basic properties of knowledge based systems. It is not surprising that this section has the closest connection to the previous section. W. Marek in his paper "Basic properties of Knowledge base systems" proposes a formalism that allows to investigate such notions as completeness and consistency of rule-based systems. This paper is written in a purely formal style — definition, theorem and proof — but it is still well understandable. Some problems of incomplete information processing are discussed in E. W. Elcock's "First order logic and knowledge representation: Some problems of incomplete systems". While classical logical systems as e.g. first order theories were proposed to express and manipulate complete collections of information, in recent years incomplete systems have become widely used in artificial intelligence. The author compares two most important systems of this kind: well-known Prolog and Absys — an assertive programming system developed by Foster and Elcock 1968. Another fundamental problem of knowledge representation is discussed in the paper "Admissible state semantics for representational systems" by J. Doyle. He proposes a particular kind of semantics and shows how it is possible to overcome many complexity problems when translating informal semantics into formal semantics by distinguishing between internal and external meanings.

The problem how to organize knowledge for really effective reasoning and retrieval, which is important for implementations, is treated in the fourth Organization section. It includes following papers: "Accelerating deductive inference: special methods for taxonomies, colours and time" by L. K. Schubert, M. A. Papalaskaris, and J. Taugher, "Knowledge organization and its role in temporal and causal signal understanding: The ALVEN and CAA projects" by J. K. Tsotsos and T. Shibera, and "SNePs considered as a fully intensional propositional semantic network" by S. C. Shapiro and J. Rappoport. Several special reasoning techniques are examined in this section together with illustration of various organization aspects of systems as above mentioned ALVEN, CAA, and SNePS.

The fifth section, called Reasoning, includes four papers. They are: "Representing virtual knowledge through logic programming" by V. Dahl, an introduction to a logic programming system that uses a uniform deductive reasoning system which can explain observations in terms of facts and hypotheses by D. Poole, R. Goebel and R. Aleliunas" Theorist: A logical reasoning system for defaults and diagnosis", the paper of R. J. Firby and D. McDermott on "Representing and solving temporal planning problems" and, eventually, B. V. Funt's paper "Analogical modes of reasoning and process modelling" in which the author discusses the nature of analogical processes and analogical representations from the point of view of parallel processing systems. He introduces a program WHISPER that uses analogs in reasoning processes. In such a way

this paper makes a bridge to the final section on Application where two knowledge-based systems are described. An interesting system Mapsee 2 is presented by W. Havens and A. Mackworth in the paper "Representing and using knowledge of visual world" and a VLSI-CADT system is described by H. Reghbati and N. Cercone, one of the editors of the whole volume.

Apart from a considerable diversity of authors styles the book is well readable and gives strong compact impression. It can be recommended to the people working in knowledge engineering, artificial intelligence and logic, but also to all who are interested in theory and/or application of knowledge-based systems.

Petr Jirků

LEONARD BOLC, Ed.

Natural Language Parsing Systems

Symbolic Computation — Artificial Intelligence.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1987.

XVIII + 367 pages; 151 figs.; DM 98,—.

One of the busiest fields in computational linguistics, especially on its practical side, has evidently been and still is the complex domain of natural language parsing (henceforth NLP). There are certainly good reasons that it should be so: a major one undoubtedly concerns the fact that NLP is the very point where an AI application is faced with (natural expressions of) human intelligence. Until recently, the interest in parsing had even overshadowed the issues of synthesis or generation, although formal descriptions of NL grammars have been usually true to the tradition of "generation grammars".

Anyway, NLP (performed by a computer) developed from its modest beginnings or largely mechanical immediate context recognition in the early machine translation systems through a period of close relatedness to the parsing of formal, especially programming languages into its present shape where the central role of linguistics is generally acknowledged. For the linguist, there are several elements involved in the construction of a parsing system: (1) a theoretical background underlying (2) a grammar (and possibly a source of semantic or even pragmatic knowledge), which is either directly incorporated into the actual implementation of the parsing program, or preferably expressed by means of (3) a grammar (or language) formalism, which can be digested (interpreted or compiled) by (4) a kind of lower-level linguistic software performing the actual parsing. There may be other points of view, stressing different facets of the problem, especially those concerning methods of the "lower-level" parsing known from the parsing of formal languages. So in what perspective does NLP appear from the point of AI?

There may be some expectations raised by the title of the book under review, which could be somewhat misleading. Note that the systems described would not concern parsing or natural language or even that the contributions would not merit publishing: nine profound studies are included dealing with NLP; their authors are mostly renowned personalities coming from institutions well-established in the fields of computational linguistics and AI. The collection is undoubtedly an interesting reading with a number of original ideas and approaches, but what the reader should not expect is a representative coverage of the recent NLP trends. A conscious bias in the editor's choice can probably be found in the relative absence of discussions concerning purely linguistic issues but otherwise a miscellany of topics is presented:

J. G. Carbonell and P. J. Hayes from Carnegie-Mellon ("Robust Parsing Using Multiple Construction-Specific Strategies") propose a parser whose strategy is dynamically selected according to what kind of construction is just being parsed. They claim that this approach is significantly more efficient in handling both ungrammatical and grammatical input, that the system can naturally represent ambiguity without duplicating unambiguous parts, that it supports

grammar development and easy access to domain data bases. There are actually two basic strategies to choose from: linear (partial) pattern matching for idioms, names etc., and case oriented strategy for other constructions. Three experimental systems are described, where it becomes clear how the selection works: the case strategy is dominant and thus the parser knows what can fill a particular case. The top-down case-frame expectations constraining bottom-up pattern-matching have the further advantage of preventing overgeneration of spurious parses. Finally, a nice multistrategy algorithm with an error recovery mechanism is described. This contribution suggests a possible solution to a few notorious NLP problems like frequent ungrammaticalities in the input and the volatility of most seemingly stable idioms.

There is another paper in this book concerned with the "vastness" of natural languages, namely that by S. L. Small from the University of Pittsburgh ("A Distributed Word-Based Approach to Parsing"). His solution aims very high: it is supposed to be "a first attempt at a psychological model of language understanding as a computationally useful system" (p. 200). The design is very revolutionary indeed. There is an underlying assumption that all fragments of language are more or less idiomatic, contrary to the prevalent analytic view. Therefore the emphasis is on words and their inherent interactions (largely semantic and pragmatic) rather than on grammar patterns. According to the author's claim no syntactic or semantic structure is built. "Word experts" for every single word interact together and with higher-order processes to come to mutual agreement on the meaning of a text fragment, working in parallel. Of course, there is a representation of some sort in the end. An experimental implementation is described, concentrating on the control mechanisms, objects involved in expert interactions, and the means for defining word experts. An example tracing a parse of a simple sentence is provided. The psychological realism is intuitively felt and there are many truths adduced to support the proposed solutions. However, there are also a few controversial places like: "Knowing the contextual meanings of the words is tantamount to understanding the meaning of the overall fragment" in a passage dealing with ambiguities (p. 162) — certainly many cases exist of purely syntactic ambiguity; or, speaking about idioms, "The sequence must be analyzed in context ... as being either a) a cohesive whole with idiosyncratic meaning, or b) a sequence having meaning through the application of more general language knowledge (i.e. typical "parsing")," (p. 163) where the either-or solution is quite unsuitable and is later in effect refuted. Some doubts may occur about the way the word experts are defined — the definition language, being procedural, seems to be rather low-level for the immense task.

M. Thiel from Lauf, FRG, involved in the SUSY MT project (Saarbrücken University) presents a systematization of the probabilistic approach applied in a few parsers (most notably in the METAL project) to cope with multitudes of parallel outputs but lacking any theoretical background. He suggests the term "Weighted Parsing" and introduces plausibility weights into the lexicon as well as into grammar rules and even higher (control) structures. The observation that weighting depends on the sublanguage is given due attention in the form of functions modifying standard weights in rules and word meanings with respect to text type and subject area.

Another ambitious project is described in J. G. Neal's and S. C. Shapiro's (State University of NY) "Knowledge-Based Parsing". The authors stress the ability of natural language to function as its own metalanguage and propose a system understanding natural language sentences about how natural language is used. There is a "kernel language" to begin with, which expresses in primitive relations the minimum amount of knowledge necessary to understand more, in a way a poor language user is taught in the same language. The knowledge base is then built on inferences from input statements. While there is allegedly no clear boundary separating syntactic, semantic and world knowledge in reality, no such boundary is created in the systems's declaratively represented knowledge and even the parser is not a separate component. Of course, a considerable price in complexity is paid, as is obvious even in the trivial examples presented.

J. Pitrat from Université Pierre et Marie Curie, Paris ("Using Declarative Knowledge for

Understanding NL'') argues for using declarative knowledge in preference to procedural, giving a number of sound arguments. He presents an interpreter which is to some extent general in the sense that the declarative knowledge formalism may take an arbitrary form, unlike specialized interpreters for certain parts of knowledge only (pragmatics, syntax) or interpreters accepting a complete NLU definition but only in a single formalism. However, it is not the usual general interpreter (PROLOG), lacking in efficiency when used to describe linguistic phenomena in a real system. According to the author, the system in its present shape (parsing chess comments in French) lacks more generality in being too input language specific (in-built word order and semantic constraints) and in not using declarative knowledge also as a means to control other (declarative) knowledge, i.e. as metaknowledge. The former complaint about word order constraints is only natural, considering the heavy dependence of the parser on Woods' Augmented Transition Networks, a formalism once very popular but now already past its prime, which is partly due precisely to the fact that it resists natural treatment of free word order.

An interesting contribution is presented by W. A. Martin, R. S. Patil (MIT), and K. W. Church (AT & T Bell Laboratories) — "Preliminary Analysis of a Breadth-First Parsing Algorithm: Theoretical and Experimental Results". The parser was constructed to test the strength of a purely syntactic approach on a very difficult corpus compiled by A. Malhotra (a collection of queries put by business users which were computer-naïve to the extent that they believed they were communicating with a machine while it was Mr. Malhotra who provided the answers). The parser is an adaptation of Earley's context-free algorithm producing allegedly all (but, as is later appears, almost all) parses using procedural grammar specification for fastness, a primary, some secondary and many minor algorithms to support modularity, and some useful linguistic ideas like Gazdar's treatment of unbound dependencies. There is an introductory part on chart parsing, a discussion of restrictions put on grammars of the relevant class and a detailed evaluation of the results comparing quantitative data obtained for the corpus and for synthetic sentences with calculated data. The correspondence is close enough to substantiate conclusions about grammar type and performance based on this data. The authors hope to extend the parser to be a practically usable tool, but one may wonder how far they can go with the programmed grammar. Some difficult grammar phenomena are classified as "exceptions" with the resulting ad hoc treatment, which need not always be the best approach.

The other contributions, which are more implementation oriented, seem to suffer more from the relatively long way to this volume. The ATN approach is prevailing while more recent developments could not be included (most references are dated around 1980 with very few later than 1983). Of course this does not say anything about their quality, only that they may have lost some of their original appeal:

T. W. Finin and M. S. Palmer (University of Pennsylvania & Burroughs Company; "Parsing with Logical Variables") use ATN with logical variables and unification, comparing the result with the Definite Clause Grammar formalism.

A. Sâgvall Hein (Språkdata, Göteborg; "Parsing by Means of Uppsala Chart Processor") describes in detail a parser of Swedish, based on R. Kaplan's General Syntactic Processor.

Finally, there is a discussion of the grammar used in a practical system in W. Dilger's "Syntax Directed Translation in the Natural Language Information System PLIDIS" (Fraunhofer-Gesellschaft, Karlsruhe). The grammar is named a tree directed grammar and it is shown that it is weaker than transformational grammars.

From what has been said so far, it should be clear that the book is not intended for newcomers, it is the very opposite of a textbook or a survey mapping the field with the aim of being relatively exhaustive. It also includes quite a number of conflicting views and some controversial ideas — there are certainly many unsolved problems in this domain, but it seems that those included are probably not so pressing today. However, if one remembers the editor's objective simply to

collect interesting research results as stated in the Preface, together with the wish to have in the near future "an extensive work presenting a complex overview of the present state of research in this field" (p. VII), no complaints can in fact be raised: every contribution included in the book is more than worth reading.

Alexandr Rosen

LEONARD BOLC, Ed.

Computational Models of Learning

Symbolic Computation — Artificial Intelligence.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1987.

IX + 208 pages; 34 figs.; DM 108,—.

This book is an interesting volume of the Springer Series "SYMBOLIC COMPUTATION — ARTIFICIAL INTELLIGENCE" and contains contributions of well known scientists working in the fields, namely G. L. Bradshaw, P. Langley, R. S. Michalski, S. Ohlsson, L. A. Rendell, H. A. Simon, and J. G. Wolff. The topics included are Learning strategies and automated knowledge acquisition (an overview), Heuristics for empirical discovery, Transfer of training in procedural learning, Conceptual knowledge acquisition in search and Cognitive development as optimization. The treatment is more or less introductory not using mathematical treatment. The volume can be useful for a reader of *Kybernetika* as a source of references to find a more advanced and detailed presentations of the topics considered.

Tomáš Havránek

E. N. HOUSTIS, T. S. PAPATHEODOROU, C. D. POLYCHONPOULOS, Eds.

Supercomputing

1-st International Conference, Athens, Greece, June 8—12, 1987, Proceedings

Lecture Notes in Computer Science 297.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1988.

Stran X + 1093; cena 138,— DM.

Recenzovaný sborník obsahuje 63 referátů rozdělených do 11 sekcí a pokrývajících velmi rozsáhlou oblast volně vymezenou termínem "Supercomputing". Témata prací jsou velmi různorodá, stejně jako profese a zaměstnavatelé autorů. To svědčí o živosti předkládaných otázek a o důležitosti, jaká je jim všeobecně přikládána. Geografické rozdělení autorů je ukázkou (byť ne zcela objektivním) objemu a intenzity prací v jednotlivých zemích — největší zastoupení má USA, několik autorů je z Japonska, u evropských příspěvků převládají autoři z NSR, Francie, Velké Británie a Itálie. Ze socialistických států jsou mezi aktivními účastníky pouze BLR a Čína.

Sborník je rozčleněn do 11 sekcí. Názvy jednotlivých sekcí neodpovídají vždy obsahu, některé příspěvky se tematicky zcela vymykají ze sekce, do níž jsou zařazeny. Doporučujeme čtenáři ignorovat při hledání předmětu jeho zájmu ne zcela šťastnou organizaci sborníku a projít všechny názvy resp. autory příspěvků.

Recenze nemůže obsahově postihnout všechny příspěvky. Pokusíme se upozornit na některé obecné rysy, které lze při čtení sborníku vysledovat, a uvést hlavní směry výzkumu s příklady (podle našeho soudu) zajímavých referátů.

Konference jako celek byla zaměřena spíše na pracovníky ve výzkumu a vývoji paralelních architektur a jejich programového vybavení než na uživatele. Z mála příspěvků zabývajících se především použitím počítačů o vysokém výkonu jsou pozoruhodné práce J. F. Hakea - W.

Homberga, umožňující nám udělat si představu o technickém a programovém vybavení při řešení PDE v KFA Jülich (NSR, ústav zaměřený na jaderný výzkum s cca 4000 zaměstnanci); R. D. Lazarova - P. S. Vassilevského - D. Margenova ukazující vysokou úroveň výzkumu dané problematiky v BLR a práce T. Karstada - A. Henrígueze - K. Korsella velmi přehledně popisující simulaci podzemních zásobníků (což je jedna z významných oblastí čistě komerčních aplikací superpočítačů).

Sborník umožňuje vytvořit si reálnou představu o složitosti hodnocení výkonnosti paralelních počítačových architektur a výběru vhodného typu počítače pro určitou aplikaci. Zásadní pohled na problém hodnocení výkonnosti přináší zvaný referát autorů D. J. Kucka - A. H. Sameha. Jeho autoři navrhli koncepci pro práce v tomto směru, ukázali složitost a praktickou důležitost diskutované otázky. Uvedený referát doplňují popisem konkrétních systémů nebo speciálních otázek další příspěvky, bohužel rozptýlené po různých sekcích sborníku. Pozornosti je možno doporučit zejména práce J. J. Dongarry vysvětlující hodnocení výkonnosti na základě provedení eliminačních algoritmů knihovny LINPACK (zveřejněné výsledky dávají krásnou představu o rozdílu mezi reálnou a teoretickou výkonností mnoha známých systémů); dále práce L. Brocharda hodnotící režijní ztráty u slabě svázaných multiprocessorových systémů, M. Cossnarda - B. Tourancheaua - G. Villarda zabývající se výkonností klasických eliminačních algoritmů na multiprocessorových architekturách a J. J. Du Croze - J. Wasniewského věnovaná implementaci BLAS na počítači Sperry ISP.

Pokud bychom hodnotili zaměření příspěvků z hlediska typu architektury, výrazně převažuje orientace na multiprocessorové systémy v obecném smyslu (t.j. zahrnujícím silně svázané multiprocessory, slabě svázané systémy a systémy-sítě, nazývané souhrnně „message-passing multiprocessor“). Menší část příspěvků je věnována architekturám vektorovým a pouhé 4 příspěvky se přímo dotýkají problematiky data flow a systolických polí. Převaha MIMD — orientovaných příspěvků je dána širokým záběrem konference neomezující se pouze na nejvýkonnější komerčně úspěšné vektorové superpočítače.

Mnoho příspěvků je věnováno základním programovým prostředkům paralelních počítačů, strategiím a optimalizaci nástrojů pro využití jejich potenciální výkonnosti. Řada příspěvků je věnována paralelním numerickým metodám a algoritmům a jejich realizaci na jednotlivých architekturách. Většinou je dávana přednost popisu dílčí otázky do značné hloubky před obecně přístupným přehledovým zpracováním širšího tématu. Mezi přehledovými referáty jsou mimo dříve zmíněných zajímavé příspěvky Y. Muraoky - T. Marushimy informující o hlavních směrech prací v oboru parallel processing v Japonsku a I. Duffa, zachycující stav oboru supercomputing v Evropě v roce 1987. I. Duff publikuje informace o rozdělení instalovaných superpočítačů podle typů, zemí a účelu použití, hodnotí dosažený stav a odhaduje možný další vývoj. Bohužel vylučuje ze svého přehledu třídu systémů nazývanou minisupercomputers a omezuje se pouze na systémy nejvyšších výkonů.

Čtenáři sborníku se vnutí otázka o stavu oboru vysoce výkonných výpočtů (což nevystihuje zcela termín supercomputing) u nás. Omezíme-li se na oblast vědecko-technických výpočtů (což odpovídá převážně většině příspěvků ve sborníku), zjistíme, že počítače s moderní (paralelní) architekturou vhodné pro vědecko-technické výpočty v domácím prostředí prakticky neexistují. A nemusíme hledat ekvivalenty velkých a nákladných systémů značky CRAY, nejsou dostupné ani ekvivalenty ve světě velmi rozšířené třídy počítačů označované jako minisuper s reálnou výkonností kolem 10 MFLOP_s a cenou kolem 200—400 tisíc \$. To značně omezuje možnosti realizace výsledků těch nadšenců, kteří se přesto snaží v oboru pracovat, a ve svém důsledku přináší velké ekonomické ztráty. Vysoký výkon při provádění vědecko-technických výpočtů není přepychem, ale nutností, která podmiňuje použitelnost výsledků a jejich ekonomický přínos pro celou společnost (např. I. S. Duff: Supercomputing in Europe — 1987). Jak vyplývá z příspěvků ve sborníku, naše zaostávání v uvedeném směru se stává hrozivým nejen vůči zemím s tradiční vysokou úrovní výpočetní techniky, ale i např. vůči BLR, Číně a Řecku.

Sborník odpovídá stavu bouřlivě se rozvíjejícího oboru v polovině roku 1987. Umožňuje čtenáři podle své vlastní odbornosti a zájmu složit si z různých pohledů celkový (byť neúplný) obraz nebo získat hlubší vědomosti o určité otázce. Většina příspěvků je určena odborníkům zabývajícím se daným tématem a předpokládá nezanedbatelnou úroveň znalostí. Sborník obsahuje málo přehledových prací psaných pro širší odbornou veřejnost. Je ho možno doporučit zejména vážným zájemcům o danou problematiku. Pro ně se stane cenným a obsáhlým zdrojem informací.

Zdeněk Strakoš

P. GORNY, M. J. TAUBER, Eds.

Visualization in Programming

**5th Interdisciplinary Workshop in Informatics and Psychology, Schärding, Austria,
May 20—23, 1986, Selected Contributions**

Lecture Notes in Computer Science 282.

Springer-Verlag, Berlin—Heidelberg—New York—London—Paris—Tokyo 1987.

Stran VII + 210; cena 36,— DM.

Knižka obsahuje vybrané příspěvky na 5. interdisciplinárním pracovním semináři informatiky a psychologie v Schärdingu, Rakousko, v r. 1986.

Výchází též semináře je skutečnost rostoucí intelektuální náročnosti programování rozsáhlých heterogenních programových celků. Jejich vytváření předpokládá schopnost udržet v mysli programátora složité a za různých podmínek vzájemně se ovlivňující komponenty funkcí deterministických, heuristických, datových celků tradičně formovaných jako soubory, i méně obvyklých jako zásobníky, fronty apod. Navíc přistupují, popř. se vnučují požadavky různorodé komunikace programátora (v pojetí knížky spíše projektanta) s průběžnými a koncovými stavy v programu. Tradiční formy lineárních zápisů jazykových konstruktů algoritmických jazyku ovládání takových programových celků ještě spíše ztěžují.

Na pomoc přicházejí poznatky psychologie a ergonomiky, které formují podmínky lepší říditelnosti takových celků a jejich vývoje. Formou, která se nejspíše nabízí jako nástroj, je vizualizace programů, jejich stavů v počítači, průběžných i konečných. Nevýhodou je, že i tyto pomáhající formy musí být naprogramovány, což je vlastním cílem úsilí o rozvoj vizualizace v programování. Pro tento cíl bylo nutno řešit otázky: co vizualizovat a jak vizualizovat.

Obsah knížky je uveden základní statí Shi Kuo Changa (universita v Pittsburgu), v níž se autor zabývá zdroji tohoto druhu programování, jimiž jsou metody poznávání, informatika a ergonomie. Smyslem je analýza možností, jak lépe porozumět a projektovat komplexní programové struktury.

Navazující příspěvky (R. Lutz, TA Triumph Adler AG, dále J. Stelovski spolu s D. Ackermannem a P. Contim z ETH Curych) se zabývají především analýzou programových struktur se speciálním zaměřením na využití systému Macpeth. S tímto příspěvkem je spojen další (J. Stelovski, D. Ackermann) se zaměřením na psychologické aspekty tvorby programových komplexů, odrážející se ve funkcích systému PRIMP-1, a příspěvky Gerrit C. van der Veera, Johna van Beeka a Guus A. N. Crutse ze Svobodné university v Amsterdamu a Gabriely Rohrové z Výzkumného centra IBM v Heidelbergu, které studují vztah mezi tvorbou programů a učením se.

Poslední skupinu představují příspěvky autorů M. J. Taubera (universita v Pittsburgu) a H. J. Hoffmanna (TH Darmstadt) a dalších, které se zabývají konkrétními případy společného rozhraní (interface) a konkrétních implementací při spolupráci člověka s počítačem.

Knižka ukazuje jak na nové směry ve výzkumu programování (kde nejde jen o grafické editory, ale i teoretickou interdisciplinární základnu takového rozvoje programování), tak na konkrétní

ních systémech jazyků programování i praktických řešení dokumentuje i užitečnou realizovatelnost takových řešení. Pro nás má tato velmi užitečná knížka i úlohu směrniče dalšího rozvoje ve výzkumu programování.

Jaroslav Vlček

THOMAS OTTMANN, Ed.

Automata, Languages and Programming

Proceedings of the 14th International Colloquium, Karlsruhe, Federal Republic of Germany, July 1987

Lecture Notes in Computer Science 267.

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Stran X + 565; cena 72,— DM.

Recenzovaná publikace je objemným sborníkem 14. mezinárodní konference ICALP (International Colloquium on Automata, Languages and Programming). ICALP je již tradičně konferencí, pokrývající téměř všechna témata teoretické informatiky. I tentokrát se programovému výboru za pomoci více než 170 recenzentů podařilo dodržet nastoupený směr. Z nabídnutých 160 příspěvků bylo vybráno 46 kvalitních prací, jež jsou ve sborníku sdruženy do následujících tematických celků: Induktivní inference, logika a funkcionální programování (3 příspěvky); Přepisovací systémy (3); Sémantika a konkurentnost (5); Formální jazyky a automaty (9); Temporální logika a konkurentní systémy (3); Paralelní a distribuované výpočty (5); Algoritmy a složitost (12); Petriho sítě, specifikace (3); Složitost (3).

Na konferenci byly dále předneseny 4 „pozvané“ přednášky, sborník však obsahuje plný text jen jedné z nich — je to brilantně napsaný aktuální přehled J. Karhumäkiho o moderních směrech teorie formálních jazyků (v důležitém příkladě na str. 143 je tisková chyba).

Specialisté v jednotlivých informatických směrech se při studiu sborníku pravděpodobně zaměří jen na vybraná témata; avšak i jako celek je sborník velmi užitečnou publikací, poskytující přehled o současném stavu oboru.

Ivan Havel