

**ALGORITHMS WITH POSSIBILITIES OF SELFLEARNING AND
SELFMODIFICATION**

Eugeniusz Eberbach

1-44

Abstract. This paper concerns a concept of selfperfecting and selflearning of digital computer systems. This idea is not new, but continuously in the state of elaborations. Such systems, i.e. with a possibility of selflearning and selfmodification would have undoubtedly greater possibilities and elastic properties in their behaviour than traditional digital systems.

In the paper a digital system is treated as a complex system of algorithms. As an abstract model of real algorithms, so called Mazurkiewicz PC-algorithm is considered. FC-algorithms used in the paper have been extended to modifiable PC-algorithms by adding a time-variant structure and the use of the notion of tolerance spaces. This structure allowed us to introduce a model of learning for modifiable FC-algorithms. Learning is understood as a goal directed process of changes of activities on the basis of experience.

Keywords: FC-algorithm - A, a modifiable FC-algorithm - MA, the i th configuration of MA - MA_i , the i th function of modification - Φ_i , a relation of tolerance - τ_P , canonical sets of equations for MA_i and for MA, a cost function - Ψ , an extended cost function $\bar{\Psi}$, a cost system R "beyond-real" numbers R^∞ , a finite learning process, a goal of learning, an optimization problem for MA, the stop-property for MA, an antigradient of the tolerance $\tau_P - \bar{\nabla}\tau_P$, a direction of the improvement, the outsider- and the inside-cost functions, a process of learning with a teacher and selflearning.

A NOTE ON MINIMIZATION OF THE SET OF ATTRIBUTES

Tomasz Imieński

45-51

Abstract. The problem of the minimization of the set of attributes (key-finding) in a given i.s.r. system is proved to be equivalent to prime implicant finding for a certain term. The equivalence between the minimalization of the set of attributes and minimal test finding is exhibited. As a consequence, minimal test finding algorithms are also applicable to the present problem.

Keywords: Information storage and retrieval, information systems.

**GENERALIZATIONS OF THE CONSECUTIVE ONES PROPERTY AND
RELATED NP-COMPLETE PROBLEMS**

Witold Lipski, Jr.

53-69

Abstract. $A(0,1)$ -matrix A is said to have the consecutive ones property if its rows can be permuted so that the 1's appear consecutively in each column. We present four NP -complete problems connected with some generalizations of this notion. These problems concern decomposing the columns of a matrix into two subsets having the consecutive ones property, decomposing the rows into three subsets having the consecutive ones property, finding a subset of rows of maximal size having the consecutive ones property, and finding a permutation of the rows such that the 1's in any column are contained in a set of k consecutive rows, for a fixed "buffer size" k .

Keywords: Computational complexity, NP -complete problems, matrices with the consecutive ones property, linear families of sets, file organization, consecutive retrieval property, storage space minimization.

REMARKS ON SEQUENTS DEFINED BY MEANS OF INFORMATION SYSTEMS

Miroslav Novotný

71-79

Abstract. Information (storage and retrieval) systems lead to define sequents of formulas of the propositional calculus. We give necessary and sufficient conditions for a formula β to be a sequent of a formula α with respect to a given information system and/or with respect to a given information system and its given valuation.

Keywords: Information system, valuation, sequent with respect to an information system, sequent with respect to an information system and its valuation

CONSTRAINED PETRI NETS

H.J.M. Goeman, L.P.J. Groenwegen, H.C.M. Kleijn, G.Rozenberg

81-125

Abstract. This paper investigates the use of sets of places of a Petri net as additional (to input places) constraints for granting concession to a transition.

Various modes of using constraints give rise to various classes (of languages) of constrained Petri nets. The power of these classes is compared in the language theoretical framework.

Keywords: Petri nets, concurrency, formal languages.

**ON THE POWER OF MODEL THEORY IN SPECIFYING ABSTRACT DATA TYPES
AND IN CAPTURING THEIR RECURSIVENESS**

Alberto Bertoni, Giancarlo Mauri, Pierangelo Miglioli

127-170

Abstract. In this paper a comparative analysis of some algebraic and model-theoretic tools to specify abstract data types is presented: our aim is to show that, in order to capture a quite relevant feature such as the recursiveness of abstract data types, Model Theory works better than Category Theory.

To do so, we analyze various notions such as "initiality", "finality", "monoinitiality", "epifinality", "weak monoinitiality" and "weak epifinality", both from the point of view of "abstractness" and of "cardinality", in a general model theoretical frame.

For the second aspect, it is shown that only "initiality", "monoinitiality", "epifinality" and "weak epifinality" allow us to select countable models (for theories with a countable language), a necessary condition to get recursive data types, while this is not the case for "finality" and "weak monoinitiality".

An extensive analysis is then devoted to the problem of the recursiveness of abstract data types: we provide a formal definition of recursiveness and show that it neither collapses, nor it is incompatible with the "abstractness" requirement. We also show that none of the above quoted categorial notions captures recursiveness.

Finally, we consider our own definition of "abstract data type", based on typically model-theoretic notions, and illustrate the sense according to which it captures recursiveness.

Keywords: Abstract data types, countability, recursiveness, homomorphisms, isomorphic embeddings.

**ON CONNECTIONS BETWEEN PARALLEL PROGRAMS AND
NONDETERMINISTIC SEQUENTIAL PROGRAMS**

Zenon Sadowski

171-183

Abstract. The paper contains an affirmative answer to the following question: Does nondeterministic sequential program equivalent with respect to the set of final valuations exist for every parallel program with semantics defined in paper [3]? It also includes an example of the construction of a nondeterministic sequential program equivalent with respect to the set of final valuations to the given parallel program.

Keywords: Semantics of parallel program, semantics of nondeterministic program, FS-expressions, flowchart-schemes.

CONTROL OF PETRI NETS BY FINITE AUTOMATA

Hans-Dieter Burkhard

185-215

Abstract. Petri nets are considered where the firings are controlled by finite automata. The control may be distributed to different automata working over disjoint sets of transitions. To avoid deadlocks and conflicts for the whole system the distribution of control must be organized in an appropriate manner. The existence of deadlocks and conflicts is shown to be undecidable in general, but conflict resolving and deadlock free controls can be constructed for given nets.

Keywords: Petri nets, automata, control of concurrent systems, conflict, deadlock.

INTERPRETABILITY OF ALGORITHMIC THEORIES

Wiktor Dańko

217-233

Abstract. In this paper we consider interpretability between algorithmic theories, i.e., formalized theories based on the Algorithmic Logic (cf. [1,3]). We adopt the notion of interpretability proposed by Szczerba (c.f. [7,8]). We show that some facts true in the case of interpretability of first order theories are also true in the case of interpretability of algorithmic theories. We give examples of hereditary and nonhereditary properties of interpretability of algorithmic theories.

Keywords: Logics of programs, algorithmic logic, interpretability between formalized theories

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ON EFFECTIVE NUMBERINGS OF EFFECTIVE DEFINITIONAL SCHEMES

Andrzej Orlicki

235-245

Abstract. We try to define effective numberings of the logic of effective definitional schemes which has been defined in Tiuryn [4]. It turns out that a reasonable way of doing it leads us to the functions which are not surjective. Thor fare in the traditional sense they are not effective numberings. However, these functions induce "good" numberings of the set of functions computable by effective definitional schemes.

Keywords: Effective definitional schemes, Godel quasi-numbering, complete numbering set.

DEPENDENCIES OF ATTRIBUTES IN PAWLAK'S INFORMATION SYSTEMS

Ewa Orłowska

247-256

Abstract. In the paper we consider dependencies of attributes in Pawlak's model of information systems. We develop a logic which enables us to express and to prove dependencies. We present a Gentzen-style deduction system for the logic.

Keywords: Information system, dependencies of attributes, propositional logic, lattice.

**PROGRAMMABILITY IN THE SET OF REAL NUMBERS AND
SECOND-ORDER RECURSION**

Kostas Skandalis

257-274

Abstract. In this paper we compare two notions of effectiveness in the ordered field of real numbers. The first one is introduced using the notion of program in the sense of algorithmic logic. The second is the recursiveness in Baire space. After an identification of the Baire space with the set of reals using an effective and natural mapping it turns out that these two notions are different. We also study a natural notion of effectiveness extending both these notions.

Keywords: Recursive, real function, programmable function, algorithmic logic.

CHAIN-CONTINUOUS ALGEBRAS A VARIETY OF PARTIAL ALGEBRAS

Ana Pasztor

275-288

Abstract. We prove that the category of ω -continuous algebras of any fixed (infinitary) signature is a variety of the category of partial algebras of an adequate signature. This enables us to derive properties of ω -continuous algebras from the thoroughly investigated properties of partial algebras.

Keywords: Continuous algebras, variety, partial algebras.

**ON A REPRESENTATION OF ROUGH SETS BY MEANS OF
INFORMATION SYSTEMS**

Miroslav Novotný, Zdzisław Pawlak

289-296

Abstract. Rough sets are investigated as a tool for expressing uncertainty of the relation "to be an element of". We give some representation theorems for rough sets expressed in terms of information systems.

Keywords: Approximation space, upper approximation, lower approximation, rough top equality, rough bottom equality, rough equality, upper rough set, lower rough set, information system.

AN INTERPRETABILITY APPROACH TO THE THEORY OF ABSTRACT DATA TYPES

Wiktor Dańko

297-332

Abstract. In this paper, similarly to [1,4,17,20,21,29,30], abstract data types are understood as formalized many-sorted theories based on algorithmic languages (e.g. a language of algorithmic logic [2,16] or a language of dynamic logic [11,29]).

Operations on data types, leading from (more) primitive types to compound typos, are defined in terms of the interpretability theory (cf. Szczerba [25]).

The approach proposed here to defining new typos accords with the methods of introducing new classes of objects in programming languages like Simula 67, Pascal, Loglan, Ada.

Keywords: Logics of programs, formalized algorithmic theories, data structures, interpretations between theories.

CONSTRAINED PETRI NETS Part II: Generalizations and extensions

H. J. M. Goeman, L. P. J. Groenewegen, H. C. M. Kleijn, G. Rozenberg

333-374

Abstract. This paper continues the investigation from [Goeman et al.] concerning the use of sets of places of a Petri net as additional (to input places) constraints for granting concession. Now interpretations of more general constraints are considered and expressed as Boolean expressions. This gives rise to various classes of constrained Petri nets. These are compared in the language theoretical framework introduced in [Goeman et al.]. An upperbound for the language defining power is found in the class of context-free programmed languages.

Keywords: Petri nets, constraints, Boolean expressions, Petri net languages.

NUMERICAL QUERIES IN INCOMPLETE INFORMATION DATA BASES

Michał Jaegermann, Witold Lipski, Jr.

375-391

Abstract. We consider the problem of answering numerical queries, i.e. queries involving cardinalities of sets of objects with specified conditions, in a data base where information is incomplete. We give an algorithm to compute a lower bound and an upper bound on the response to a numerical query. The bounds produced by the algorithm are the best logically derivable from the information available in the data base.

Keywords: Incomplete information, query languages, data bases.