DYNAMIC HIERARCHICAL DEPENDENCY

Keh-Hsun Chen *1-12*

Abstract. In this paper, a new kind of dependencies for databases, called dynamic hierarchical dependencies (OH-dependencies), is proposed and studied. DH-dependencies naturally suit DH-databases, which are based on Sandwall's dynamic data hierarchy structure. An efficient inference algorithm on OH-dependencies is proposed and its correctness is proved. Information retrieval with DH-dependencies is investigated.

ALGEBRAIC OPERATIONS ON RESTRICTED CARDINALITY SETS IN RELATIONAL DATABASES

Zbigniew Michalewicz and Lindsay Groves *13-28*

Abstract. A number of approaches have been taken to incorporating sets in relational databases. We review three such approaches and discuss a new approach, called restricted cardinality sets, which combines aspects of the other approaches, allowing both compound values and incomplete information to be represented. We show that this approach generalizes the other approaches, leading to a simpler, more flexible representation; and discuss the definition of algebraic operations on such sets

ML-SMART: A PROBLEM SOLVER FOR LEARNING FROM EXAMPLES

F. Bergadano, R. Gemello, A. Giordana, and L. Saitta *29-50*

Abstract. This paper describes Mt-SMART, a knowledge based system for inducing concep-tual description from examples. It is organized as a problem solver and makes an integrated use of multiple search strategies, including characterization, constructive learning and deduction. The acquired knowledge consists of production rules organized into a network, which can be seen as a generalization of a decision tree. The condition part of the rules is expressed in a first order logic language also containing numerical quantification. The use of variables and functions al-lows highly structured con-cepts to be easily described. ML-SMART (Similarity-based Multiple-concept Acquisition and Reasoning Tool) is a domain independent system, provided with a friendly interface to ease the task of configuring a new application. It is well suited to work in noisy envi-ronments and has been tested in different domains for the sake of comparison with other existing systems.

SOLVING THE LINGUISTIC PROBLEMS IN LEARNING

Ranan B. Banerji *51-78*

Abstract. In some previous papers I have made efforts at drawing attention to some crucial repre-sentational problems standing in the way of learning and at clarifying the technical underpinnings of these. These problems occur both in learning from examples and in learning from explanations. In the introduction to this paper these problems are reiterated in summary. It is also pointed out that they have direct implications in the way one attaches statistical significance to concepts learned

from examples. Later sections to this paper describes an effort being made at present to develop a learning algorithm which uses a flexible language of represenation. The algorithm has a limited amount of ability to modify the representa-tion language. The limitations of the method are also discussed.

LEARNING CONCEPT DESCRIPTIONS IN A GROWING LANGUAGE

Zbigniew W. Ras, and Maria Zemankova   *79-96*

Abstract. Humans are capable of producing compact high-level concept descriptions built from previously known concepts and attribute values. In the method presented here, initially concepts are described in terms of attribute values. These descriptions are in a probabilistic DNF form. Assuming a growing language, concepts already known to the system can be used in describing new concepts. The order of teaching the concepts is the key to producing their optimal descriptions. By "optimal" we mean the minimum number of occurrences of constants in descriptions. The problem of finding the minimal description for each concept is NP-complete, hence our proposed algorithm has to be heuristic. Our strategy is based on clustering terms in concept descriptions in order to replace them by shorter higher level terms. Results of the algorithm are optimized concepts descriptions in terms of a growing language, and a concept network that can be used for further learning and reasoning within the concept knowledge base.

AN EQUIVALENCE OF COMMUNICATING PROCESSES IN DISTRIBUTED ENVIRON-MENTS

Jazef Winkowski   *97-128*

Abstract. The equivalence of communicating processes with respect to their external behaviour is formalized and studied. The processes are represented by mathematical systems related to labelled event structures. The equivalence is similar to the known observational equivalence but it is defined in a manner wich reflects how processes behave in distributed environments. It is shown that the introduced equivalence is a congruence with respect to operations as in CCS (Milner's Calculus of Communicating Systems). K e y w o r d s: process, action, occurrence, event, configuration, event structure, configuration system, sum, prefixing, composition, restriction, renaming, approximation order, fixed-point, observation, transition, simulation, bisimulation, equivalence

A GOOD NORMAL FORM FOR RELATIONAL DATABASES

Zbigniew Michalewicz, and Alvin Yeo   *129-138*

Abstract. In the conceptual design of relational databases one of the main goals is to create a conceptual scheme, which minimize redundancies and eliminate deletion and addition anomalies, i.e. to create relation schemes in some good normal form. The study of relational databases has produced a host of normal forms: 2NF, 3NF, Elementary-Key Normal Form, 4NF, Weak 4NF, PJ/NF, DK/NF, LTKNF, (3,3)NF, etc. There are two features which characterize these normal forms. First, they consider each relation separately. We believe that a normal form (which reflects the goodness of the conceptual design) should be related to the whole conceptual scheme. Second, the usefullness of all normal forms in relational database design have been based ou the assumption that a data definition language (DDL) of a database management system (DBMS) is able to enforce key dependencies. However, different DDLs have different capabilities in defining constraints. In this paper we will discuss the design of conceptual relational schemes in general. We will also define a good normal form (GNF) which requires a minimally rich DDL; this normal form is based only on a primitive concept of constraints. We will not, however, discuss the normalization process itself Ů how one might, if possible, convert a relation scheme that is not in some normal form into a collection of relation schemes each of which is in that normal form.

THE ALGEBRA OF SYNCHRONOUS PROCESSES

W.P. Weijland   *139-162*

Abstract. An algebraical theory called ASP is presented, describing synchronous cooperation of processes. The theory ASP was first mentioned in BERGSTRA & KLOP [4] as an alternative for the theory ACP, which works with asynchronous cooperation (see also in [5]). One of the main differences between ASP, as it is presented here, and the algebraic theory SCCS of MILNER [9] is the representation of parallelism, which is done by considering a computation step as a vector, each component of which represents an atomic action on a corresponding channel. This paper concludes with an example, to give an idea how to work with ASP.

DECIDABILITY OF FORMULAS IN GRAPH THEORY

Louise E. Moser   *163-180*

Abstract. A decision procedure is given for determining the validity of unquantified for-mulas in graph theory. The procedure, which decides equality and containment relations for vertex, edge, and graph terms, reduces to a decision procedure for propositional calculus. The correctness of the procedure is proved using model theory based on the axioms for graph theory provided. The complexity of the algorithm and its limitations are discussed.

ON THE X DEFINABLE HIGHER ORDER BOOLEAN OPERATIONS

Marek Zaionc   *181-190*

Abstract. The purpose of this work is to show the methods of representing higher order boolean functionals in the simple typed X calculus. In the paper is presented an algorithm for construction the X representation of a functional given by generalized truth table. This technique is useful especially in functional programming languages such as ML in which functionals are expressed in the form of typed X terms. Also X representability of higher order functionals in many valued logics is discussed. Keywords boolean operations, typed X calculus, representability.

ON TEMPORAL LOGIC FOR DISTRIBUTED SYSTEMS AND ITS APPLICATION TO PROCESSES COMMUNICATING BY INTERRUPTS

Andrzej Szalas, and Uwe Petermann   *191-204*

Abstract. We present a temporal logic suitable for axiomatic specification of properties of distributed systems. The temporal logic considered is first-order with atnext operators interpreted as local modalities. Its semantics, different from those provided in other approaches, does not rely on .a succesor relation in a set of global states, and mirrors the nature of distributed computations. The logic introduced is applied to axiomatization of a process communication scheme based on sending and handling interrupts.

Key words axiom system, communication mechanism, distributed system, interrupt, semantic consequence, semantics of concurrent computations, temporal logic

ON THE CONSTRUCTION OF OPTIMAL TIME ADDERS

Bernd Becker, and Reiner Kolla   *205-220*

Abstract. In this paper we present the design of a novel optimal time ad-der: the conditional carry adder. In order to perform addition a tree-like combination of multiplexer cells is used in the carry computation part. We show that, for the complete conditional carry adder, this results in an overall computation time which seems to be substantially shorter than for any other known (optimal time adder (e.g. carry look ahead adders ([5]) or conditional sum adders ([12]). The second part of this paper contains a uniform approach to the computation of the carry function resulting in seven different classes of optimal time adders. It is shown that the cond-itional carry adder and the carry look ahead adder are representatives of two different classes. While section 1 defines the conditional carry adder and proposes a realization which is very time efficient, section 2 provi-des the possibility to compare this choice with other possible realizations and to choose a different design depending e.g. on specific properties of a given technology.

ABSTRACTION AND EMPTY PROCESS IN PROCESS ALGEBRA

J.C.M. Baeten, and R.J. Van Glabbeek   *221-242*

Abstract. In this paper, we combine the hidden step 11 of the authors' paper [2] with the empty process a of VRANCKEN [12] and the authors' [3]. We formulate a system ACPc, which is a conservative extension of the systems ACP,i, ACP4, but also of ACP,. This is a general system, in which most relevant issues can be discussed. Abstraction from internal steps can be achieved in two ways, in two stages: we can abstract to the hidden step rj, and then from rt to Milner's silent step T. Note: Partial support received from the European Communities under ESPRIT contract no. 432, An Integrated Formal Approach to Industrial Software Development (Meteor).

STABLE THEORIES IN AUTOEPISTEMIC LOGIC

W. Marek   *243-254*

Abstract. We investigate the operator producing a stable theory out of its objective part (A stable theory is a set of beliefs of a rational agent). We characterize the objective parts of stable theories. Finally, we discuss the predicate calculus case.

NEGATION AS FAILURE TO PROVE AND FIXED POINTS

Abstract. We investigate solutions of fixed point equations related to the negation as "failure to prove" rule, and show their relevance to minimal models. Keywords: Closed World Assumption, negation as failure to prove, logic, fixed points.

TWO APPLICATIONS OF MODEL-THEORETIC FORCING TO LIPSKI'S DATA BASES WITH INCOMPLETE INFORMATION

Abstract. This paper concerns two aspects of incomplete information in data bases: - computations of answers to queries which are externally interpreted in some incomplete first-order structures with dependencies, and - the proper treatment of modal operators in such structures. We introduce the notion of an incomplete first-order structure with dependencies which seems to be an adequate model of data bases with incomplete information. We show that the widely accepted implicit assumption that first-order models (of a data base) have a unique domain, has no first-order consequences if the set of premises (represented in the data base) contains only a finite amount of information explicitly involving the elements of this domain. This observation allows us to evaluate the degree of unsolvability of the problem of answering externally interpreted queries in the incomplete first-order structures. Moreover, we propose a forcing-based definition of the internal interpretation of modal queries in such structures, and investigate some of the properties of this inter-pretation.

EQUIVALENCE RELATIONS OF NON-DETERMINISTIC IANOV-SCHEMES

Abstract. We consider three different meanings of a non-deterministic Ianov-scheme with respect to infinite computations: trace-semantics, Plotkin-semantics, and Smyth-semantics. The corresponding equivalence relations are shown to be decidable.

PARALLEL AND DISTRIBUTED PROCESSABILITY OF OBJECTS

Abstract. Partitioning and allocating of software components are two important parts of software design in distributed software engineering. This paper presents two general algorithms that can, to a limited extent, be used as tools to assist in partitioning software components represented as objects in a distributed software design environment. One algorithm produces a partition (equivalence classes) of the objects, and a second algorithm allows a minimum amount of redundancy. Only binary rela-tionships of actions (use or non-use) are considered in this paper.

Keywords: distributed processing; computing in parallel; partitioning and allocating algorithms; object-oriented development

TOPOLOGICAL MODEL SET DEFORMATIONS IN LOGIC PROGRAMMING

Abstract. Given a first order language L, and a notion of a logic r w.r.t. L, we investigate the topological properties of the space of L-structures for L. We show that under a topology called

the query topology which arises naturally in logic programming, the space of L-models (where L is a decent logic) of any sentence (set of clauses) in L may be regarded as a (closed, compact) T4-space. We then investigate the properties of maps from structures to structures. Our results allow us to apply various well-known results on the fixed-points of operators on topological spaces to the semantics of logic programming Ů in particular, we are able to derive necessary and sufficient topological conditions for the completion of covered general logic programs to be consistent. Moreover, we derive sufficient conditions guaranteeing the consistency of program completions, and for logic programs to be determinate. We also apply our results to characterize consistency of the unions of program completions.

CONSTRUCTIONS OF GRAMMARS BY MEANS OF REDUCING OPERATORS

Abstract. In UM] a reducing operator p was defined assign-ing a normed generalized grammar p(G) to any formed gener-alized grammar G in such a way that p(G) is in a certain sense less or equal to G and that both G and p(G) generate the same language. To any nontrivial language (V,L) a normed generalized grammar Gr(V,L) is assigned. Then p(Gr(V,L)) is proved to be a normed grammar if and only if (V,L) is a so called agreeable language. Key words: normed generalized grammar, normed grammar, reducing operator, permitting triple with derivatives, canonical permitting triple with derivatives, agreeable language

LOGBASE Ů LOGIC DATABASE SYSTEM

BIALGEBRAS: SOME FOUNDATIONS FOR DISTRIBUTED AND CONCURRENT COMPUTATION

Abstract. A categorical bimonoid consists of a monoid and a comonoid which act homomorphically on one another. In applications bimonoids are typically called bialgebras or Hopf algebras. The definitions are given at a level suitable to computer science applications and examples are included. The elements of the theory of graded bialgebras are devel-oped and we provide a universal recursion theorem for morphisms between algebras and between coalgebras. With this theory we explicate refinements of concurrent programs and give a treatment of traces. The concluding section characterizes all coalgebras which interact with the match algebra to form a bialgebra and characterizes all algebras which interact with the fork (diagonal) coalgebra to form a bialgebra.

ON TIME AND SPACE REQUIREMENTS FOR PUSHDOWN AUTOMATA OF HIGHER ORDER

A GENERALIZATION OF COOK'S AUXILIARY-PUSHDOWN-AUTOMATA THEOREM

A NONMONOTONIC LOGIC OF BELIEF

Abstract. A nonmonotonic logic of belief based on a combined monotonic logic of knowl-edge and belief is presented. Unlike previous nonmonotonic logics of be-lief, this logic contains an unless operator by means of which preference for beliefs and refutation of those beliefs can be expressed, thereby provid-ing explicit representation of nonmonotonicity. A decision procedure based on Kripke structures for deciding validity of formulas in the logic is described and proved correct.

COMBINATORY LOGIC AS MONOIDS

THE LAMBDA ABSTRACTION STRATEGY FOR PROGRAM DERIVATION

Abstract. In a previous paper of ours [Pettorossi-Skowron 87] we have introduced the higher order generalization strategy (also called lambda abstraction strategy) and we have indicated through some examples its use for the automatic derivation of programs. Here we study that strategy in more detail and we analyze its capabilities for obtaining highly efficient programs, considering also some cases in which other known strategies for program development do not work. AMS Subject Classification: 68B05 (General Theory of Programming), 68B10 (Analysis of Programs), 68CO5 (Algorithms), 68C20 (Symbolic Computation). A preliminary version of this paper has been published in the Journal of Information Processing and Cybernetics EIK (1989) 5/6 (Berlin, DDR), pp. 263-281.

A NOTE ON THE MEDIAN HEURISTIC FOR DRAWING BIPARTITE GRAPHS

Abstract. Eades and Wormald have shown that a bipartite graph drawn by the median heuristic has at most three times the number of edge crossing in the corresponding optimal drawing. In this paper we show that the bound of Eades and Wormald can be sharpened. Key Words and Phrases: bipartite graph, graph drawing, median heuristic, average heuristic, edge crossing. CR Categories: F.2.2, G.2.2.

SOME STRUCTURAL PROPERTIES OF SYSTOLIC TREE AUTOMATA

Abstract. We prove that the classes of languages accepted by systolic automata over t-ary trees (t-STA) are always either equal or incomparable if one varies t. We introduce systolic tree automata with base (T(b)-STA), a subclass of STA with interesting properties of modularity, and we give a necessary and sufficient condition for the equivalence between a T(b)-STA and a t-STA, for a given base b. Finally, we show that the stability problem for T(b)-STA is decidible.