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A SEMANTIC APPROACH TO FAIRNESS

J.J.M.M. Rutten, J.I. Zucker

Abstract. In the semantic framework of metric process theory, we undertake a general investigation of fairness of processes from two points of view: (1) intrinsic fairness of processes, and (2) fair operations on processes. Regarding (1), we shall define a "fairification" operation on processes called Fair such that for every (generally unfair) process p the process Fair(p) is fair, and contains precisely those paths of p that are fair. Its definition uses systematic alternation of random choices. The second part of this paper treats the notion of fair operations on processes: suppose given an operator on processes (like merge, or infinite iteration), we want to define a fair version of it. For the operation of infinite iteration we define a fair version, again by a "fair scheduling" technique. 1980 Mathematical Subject classification: 68B10, 68C01, 68CO5. 1986 Computing Reviews Categories: D.1.3, F.1.2.

Keywords: Fairness, semantic domains of metric processes, fair infinite iteration, alternation of random choices.

ON THE COMPACTNESS THEOREM OF PROPOSITIONAL TEMPORAL LOGICS

Martin Leischner

Abstract. For a semantics SEM of a logical language an associated semantics SEM is constructed by topological means such that the compactness theorem is true in SEM. The formulas in , which are valid with respect to SEM, are identical to the formulas which are valid with respect to SEM. The concepts developed in the paper are illustrated by examples from the field of propositional temporal logics. This paper has its roots in the following topological proof of the compactness theorem of classical propositional logic: the given semantical domain (that is, in the case of classical propositional logic, the set of Boolean valuations) is interpreted as a topological space and is proved to be compact; from this one can get to the compactness theorem. This topological method is analyzed and developed in this paper in order to extend its field of application to more general semantical structures. This paper is divided into three parts: The first part contains the means from the field of topology (especially uniform spaces) which are necessary for the main body of the paper. in the second part a very general concept of a semantics SEM for a given logical language G is introduced (Definition 2.1). Then, in Definition 2.2, with the topological means of part one, an associated semantics SEM is introduced for SEM such that the compactness theorem holds for SEM (Theorem 2.6). Theorem 2.4 shows that every formula that is valid in SEM is also valid in SEM and vice versa. Assertions concerning the relationship of SEM, SEM and the validity of the compactness theorem may be found in Theorem 2.7. The construction of SEM is based on a compactification of SEM, which is similar to the Stone-Cech-compactification; within the theory of uniform spaces SEM can be characterized as the Hausdorff completion of SEM (cf. Theorem 1.7 and Construction 1.8). This characterization implies some important properties of SEM (e.g. Theorem 2.10). In the last part of the paper the techniques which have been developed are illustrated in detail by means of examples from the field of propositional temporal logics; the relationship between SEM and SEM is hereby particularly analyzed (Theorems 3.7, 3.9). Theorem 3.10 contains a temporal language in which the compactness theorem

ON CONSISTENCY AND COMPLETENESS OF AUTOEPISTEMIC THEORIES

Michael Gelfond and Halina Przymusinska *59-92*

Abstract. In this paper we expand the results on existence and uniqueness of stable autoepistemic expansions for finite stratified autoepistemic theories to the infinite case. We also introduce a notion of the closed world completion of autoepistemic theory T, which can be viewed as an autoepistemic version of Closed World Assumption. We describe a class of autoepistemic theories called strongly stratified and prove that closed world completions of such theories have consistent stable autoepistemic expansions.

ON THE GENERATIVE CAPACITY OF CONTEXT-FREE MATRIX GRAMMARS OVER ONE-LETTER ALPHABET

Erkki Makinen *93-97*

Abstract. This note studies the conjecture that context-free matrix languages over one-letter alphabet are regular. We are able to confirm the conjecture in a special case where at most one nonterminal can have an unbounded number of occurrences in sentential forms.

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Abstract. In this paper the classes of extensional models of higher-order partial conditional specifications are studied, with the emphasis on the closure properties of these classes. Further it is shown that any equationally complete inference system for partial conditional specifications may be extended to an inference system for partial higher-order conditional specifications, which is equationally complete w.r.t. the class of all extensional models, Then, applying some previous results, a deduction system is proposed, equationally complete for the class of extensional models of a partial conditional specification. Finally, turning the attention to the special important case of term-extensional models, it is first shown a sound and equationally complete inference system and then necessary and sufficient conditions are given for the existence of free models, which are also free in the class of term-generated extensional models.

Abstract. This is an exercise in the description of programming languages as indexed categories. Type classes have been introduced into functional programming languages to provide a uniform framework for 'overloading'. We establish a correspondence between type classes and comprehension schemata in categories. A coherence result allows us to describe subclasses and implicit conversions between types.

Abstract. The functional fragment of Landin's ISWIM as implemented by the SECD machine is the paradigm of the procedural kernel of many programming languages. We investigate and compare operational, denotational and logical descriptions of the ISWIM-SECD system. Our goal is to illustrate how to derive from each of these descriptions logical tools for resoning about termination and equivalence of programs. First we show the correctness and incompleteness of the canonical denotational semantics. Then we give a fully abstract quotient semantics using a notion of applicative bisimulation. We discuss next a finitary logical description of the denotational semantics. This takes the form of a call-by-value intersection type assignment system. Finally we study this type assignment system for its own sake and give a completeness result for it with respect to a natural notion of interpretation.

Abstract. Weak Observational Congruence (woc) defined on CCS agents is not a bisirnulation since it does not require two states reached by bisimilar computations of woc agents to be still woc, e.g. ct.r./ 3.nil and oe.(3.nil are woc but r./3.nil and /3.nil are not. This fact prevent us from characterizing CCS semantics (when T is considered invisible) as a final algebra, since the

semantic function would induce an equivalence over the agents that is both a congruence and a bisimulation. In the paper we introduce a new behavioural equivalence for CCS agents, which is the coarsest among those bisimulations which are also congruences. We call it Dynamic Observational Congruence because it expresses a natural notion of equivalence for concurrent systems required to simulate each other in the presence of dynamic, i.e. run time, (re)configurations. We provide an algebraic characterization of Dynamic Congruence in terms of a universal property of finality. Furthermore we introduce Progressing Bisimulation, which forces processes to simulate each other performing explicit steps. We provide an algebraic characterization of it in terms of finality, two logical characterizations via modal logic in the style of HAIL and a complete axiomatization for finite agents (consisting of the axioms for Strong Observational Congruence and of two of the three Milner's r-laws). Finally, we prove that Dynamic Congruence and Progressing Bisimulation coincide for CCS agents.

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OPERATIONAL AND DENOTATIONAL SEMANTICS WITH EXPLICIT CONCURRENCY

Manfred Broy *201-229*

Abstract. The semantics of a simple language for describing tightly coupled "synchronous" systems is defined in terms of action structures representing histories of computations with explicit concurrency. An operational semantics is defined by term rewriting rules labelled by action structures. A consistent denotational semantics in terms of action structures is defined based on the concept of observable behaviour and on fixpoint theory. A fully abstract denotational semantics is given. In particular, the issue of interleaving semantics versus semantics including explicit concurrency is discussed.

A MODAL SEMANTICS OF NEGATION IN LOGIC PROGRAMMING

Philippe Balbiani *231-262*

Abstract. The beauty of modal logics and their interest lie in their ability to represent such different intensional concepts as knowledge, time, obligation, provability in arithmetic, ... according to the properties satisfied by the accessibility relations of their Kripke models (transitivity, reflexivity, symmetry, well-foundedness, ...). The purpose of this paper is to study the ability of modal logics to represent the concepts of provability and unprovability in logic programming. The use of modal logic to study the semantics of logic programming with negation is defended with the help of a modal completion formula. This formula is a modal translation of Clark's formula. It gives soundness and completeness proofs for the negation as failure rule. It offers a formal characterization of unprovability in logic programs. It characterizes as well its stratified semantics.

NOTES ON THE ALGEBRAIC APPROACH TO DEPENDENCE IN INFORMATION SYSTEMS

Jiří Novotný and Miroslav Novotný *263-273*

Abstract. The concept of the relation of dependence between sets of attributes of an information system is studied in a more abstract setting - in the algebraic structure called dependence space. Complete characterization of dependence relation in a dependence space is presented.

ON A PROBLEM CONCERNING DEPENDENCE SPACES

Miroslav Novotný and Zdzislaw Pawlak *275-287*

Abstract. A set Y of attributes of an information system is said to be dependent on a set X of attributes if the classification of objects defined by X is finer or as fine as the classification defined by Y. An important problem reads as follows. If Y depends on X find a minimal $X' \subseteq X$ such that Y depends on X'. A set X' is said to be a reduct of X if X' is a minimal subset of X defining the same classification of objects as X. The paper is devoted to the study of relationship between reducts and dependence. Both dependence and reducts can be defined in the so called dependence spaces and the above mentioned problem can be transformed into the problem of constructing reducts in a suitable dependence space. We also present some algorithms providing reducts in a dependence space; in this way, we obtain an algorithmic solution of our problem.

Keywords: information system, dependence space, reduct, dependence.

A HIERARCHY OF SYSTEM DESCRIPTIONS VIA ATOMIC LINEAR REFINEMENT

Roberto Gorrieri *289-336*

Abstract. The problem of relating system descriptions at different levels of abstraction is studied in the field of Process Description Languages, following the so-called interleaving approach. Since we believe that several different languages should be used profitably during the hierarchical specification process, we investigate the problem of implementing a calculus into another one. As a case study, we introduce a pair of languages which will be increasingly enriched. The basic languages are sequential and nondeterministic; their first enrichment is obtained by adding an operator for asynchrony; then also communication is added, and finally restriction is dealt with. For each pair, the latter language extends the former with atomicity, obtained by adding to the signature of the former an operator of strong prefixing that makes atomic the execution of a sequence of actions. The two languages are intended to be a specification and an implementation language, respectively. To directly relate them, a mapping, called atomic linear refinement, is introduced from actions of the former to atomic sequences (i.e. sequences of actions built with strong prefixing) of the latter. An atomic linear refinement can be homomorphically extended to become a mapping among process terms of the two languages and thus also among the states of their associated transition systems. A notion of implementation, based on a sort of bisimulation (parametric with respect to an atomic action refinement), relates processes of the two languages. Given a specification process p and an atomic action refinement p, the refined process $p(p)$ is proved to be an implementation of p. Moreover, a complete proof system for strong and weak equivalence are presented for both languages (and thus also for the operator of strong prefixing) and proved consistent with respect to refinement: if p and q are congruent processes of the specification language, then $p(p)$ and $p(q)$ are congruent, too.

FURTHER REMARKS ON REDUCED LANGUAGES

Gheorghe Paun, Miklos Szijarto, Sorina Vicolov *337-347*

Abstract. Union, homomorphic and inverse homomorphic representations of languages are obtained, starting from reduced languages introduced in earlier formal language approaches to parallel program schemes. The reducedness decidability is also investigated (it is decidable for regular and undecidable for linear languages).

A REPRESENTATION OF PARTIAL BOOLEAN ALGEBRAS

Andrzej Ehrenfeucht, Marek W. Zawadowski *349-353*

Abstract. We prove that every partial boolean algebra is isomorphic to a partial boolean algebra of sets. As a consequence we obtain finite axiomatization of the theory of partial boolean algebras.

LEARNING PROGRAMS WITH AN EASY TO CALCULATE SET OF ERRORS

William I. Gasarch, Ramesh K. Sitaraman, Carl H. Smith and Mahendran Velauthapillai 355-370

Abstract. Within the study of inductive inference a recurring theme has been to investigate the learning of programs that are not exactly correct. Previous work attempted to quantify the difference between the function to be learned and the one computed by the result of a learning process.

In this paper we study a qualitative measure of approximate correctness of the result of attempting to learn a program for a given function. What we require is that the set of errors be somehow easy to describe.

LOGIC FOR INFORMATION SYSTEMS

Cecylia M. Rauszer *371-382*

Abstract. In the paper we consider a logical system called Decision Logic which may be used as a tool in the investigations of information systems. We provide two axiomatizations of that logic. One follows from the properties of information systems. The latter is in the style of proof theory. We prove the soundness and completeness theorems and show that both axiomatizations provide the same set of true formulae.

INDUCTIVE MODAL LOGICS

Dimiter Vakarelov *383-405*

Abstract. The main aim of this paper is to study inductive modal logics - bi-modal logics, containing the Segerberg's induction axiom Seg, known from PDL. An adequate semantical characterization of Seg is given, and completeness theorems for a number of inductive modal logics are proved by a generalization of Segerberg's filtration from PDL.