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Forthcoming Papers

F. Giunchiglia and P. Traverso, A metatheory of a mechanized object theory

In this paper we propose a metatheory, MT which represents the computation which implements its object theory, OT, and, in particular, the computation which implements deduction in OT. To emphasize this fact we say that MT is a *metatheory of a mechanized object theory*. MT has some "unusual" properties, e.g. it explicitly represents failure in the application of inference rules, and the fact that large amounts of the code implementing OT are partial, i.e. they work only for a limited class of inputs. These properties allow us to use MT to express and prove tactics, i.e. expressions which specify how to compose possibly failing applications of inference rules, to interpret them procedurally to assert theorems in OT, to compile them into the system implementation code, and, finally, to generate MT automatically from the system code. The definition of MT is part of a larger project which aims at the implementation of self-reflective systems, i.e. systems which are able to introspect their own code, to reason about it and, possibly, to extend or modify it.

K.M.-K. Yip, Model simplification by asymptotic order of magnitude reasoning

One of the hardest problems in reasoning about a physical system is finding an approximate model that is mathematically tractable and yet captures the essence of the problem. This paper describes an implemented program AOM which automates a powerful simplification method. AOM is based on two domain-independent ideas: self-consistent approximations and asymptotic order of magnitude reasoning. The basic operation of AOM consists of five steps: (1) assign order of magnitude estimates to terms in the equations, (2) find maximal terms of each equation, i.e., terms that are not dominated by any other terms in the same equation, (3) consider all possible n-term dominant balance assumptions, (4) propagate the effects of the balance assumptions, and (5) remove partial models based on inconsistent balance assumptions. AOM also exploits constraints among equations and submodels. We demonstrate its power by showing how the program simplifies difficult fluid models described by coupled nonlinear partial differential equations with several parameters. We believe the derivation given by AOM is more systematic and easily understandable than those given in published papers.

B. Selman and H.J. Levesque, Support Set Selection for abductive and default reasoning

Of all the possible ways of computing abductive explanations, the ATMS procedure is one of the most popular. While this procedure is known to run in exponential time in the worst case, the proof actually depends on the existence of queries with an exponential number of answers. But how much of the difficulty stems from having to return these large sets of explanations? Here we explore abduction tasks similar to that of the ATMS, but

Elsevier Science B.V.

which return relatively small answers. The main result is that although it is possible to generate some nontrivial explanations quickly, deciding if there is an explanation containing a given hypothesis is NP-complete, as is the task of generating even one explanation expressed in terms of a given set of assumption letters. Thus, the method of simply listing all explanations, as employed by the ATMS, probably cannot be improved upon. An interesting result of our analysis is the discovery of a subtask, we call the Support Set Selection Task, that is not only at the core of generating explanations, but is also at the core of generating extensions in Reiter's default logic. Moreover, it is this subtask that accounts for the computational difficulty of both forms of reasoning. This establishes for the first time a strong connection between computing abductive explanations and computing extensions in default logic.

P. Haddawy, A logic of time, chance, and action for representing plans

This paper integrates logical and probabilistic approaches to the representation of planning problems by developing a first-order logic of time, chance, and action. We start by making explicit and precise commonsense notions about time, chance, and action central to the planning problem. We then develop a logic, the semantics of which incorporates these intuitive properties. The logical language integrates both modal and probabilistic constructs and allows quantification over time points, probability values, and domain individuals. Probability is treated as a sentential operator in the language, so it can be arbitrarily nested and combined with other logical operators. The language can represent the chance that facts hold and events occur at various times. It can represent the chance that actions and other events affect the future. The model of action distinguishes between action feasibility, executability, and effects. We present a proof theory for the logic and show how the logic can be used to describe actions in such a way that the action descriptions can be composed to infer properties of plans via the proof theory.

G. Schwarz, On embedding default logic into Moore's autoepistemic logic (Research Note)

Recently Gottlob proved (1993) that there does not exist a faithful modular translation of default logic into autoepistemic logic, and presented a non-modular translation. Gottlob's translation, however, is indirect (it uses "nonmonotonic logic N" as an intermediate point), quite complex and exploits sophisticated encoding of proof theory in autoepistemic formulas. We provide a simpler and more intuitive (non-modular) direct translation. In addition, our argument is purely model theoretic.

Special Volume on Frontiers in Problem Solving: Phase Transitions and Complexity (T. Hogg, B. Hubermann and C. Williams, Guest Editors)

T. Hogg, B. Hubermann and C. Williams, Phase transitions and the search problem (Editorial)

B. Selman, D.G. Mitchell and H.J. Levesque, Generating hard satisfiability problems

J.M. Crawford and L.D. Auton, Experimental results on the crossover point in random 3-SAT

I.P. Gent and T. Walsh, The satisfiability constraint gap

P. Prossner, An empirical study of phase transitions in binary constraint satisfaction problems

D.G. Mitchell and H.J. Levesque, Some pitfalls for experimenters with random SAT

T. Hogg, Refining the phase transition in combinatorial search

B.M. Smith and M.E. Dyer, Locating the phase transition in binary constraint satisfaction problems

J.W. Freeman, Hard random 3-SAT problems and the Davis–Putnam procedure

R. Schrag and J.M. Crawford, Implicates and prime implicates in random 3-SAT

W. Zhang and R.E. Korf, A study of complexity transitions on the Asymmetric Traveling Salesman Problem

T. Bylander, A probabilistic analysis of propositional STRIPS planning

B. Selman and S. Kirkpatrick, Critical behavior in the computational cost of satisfiability testing

J.C. Pemberton and W. Zhang, Epsilon-transformation: exploiting phase transitions to solve combinatorial optimization problems

S.H. Clearwater and T. Hogg, Problem structure heuristics and scaling behavior for genetic algorithms