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Learning and inferring transportation routines

Volume 171, Issues 5-6, April 2007, Pages 311-331
Liao, L. | Patterson, D.J. | Fox, D. | Kautz, H.

This paper introduces a hierarchical Markov model that can learn and infer a user's daily movements through an urban community. The model uses multiple levels of abstraction in order to bridge the gap between raw GPS sensor measurements and high level information such as a user's destination and mode of transportation. To achieve efficient inference, we apply Rao-Blackwellized particle filters at multiple levels of the model hierarchy. Locations such as bus stops and parking lots, where the user frequently changes mode of transportation, are learned from GPS data logs without manual labeling of training data. We experimentally demonstrate how to accurately detect novel behavior or user errors (e.g. taking a wrong bus) by explicitly modeling activities in the context of the user's historical data. Finally, we discuss an application called "Opportunity Knocks" that employs our techniques to help cognitively-impaired people use public transportation safely.

Argumentation in artificial intelligence

Volume 171, Issues 10-15, July 2007, Pages 619-641
Bench-Capon, T.J.M. | Dunne, P.E.

Over the last ten years, argumentation has come to be increasingly central as a core study within Artificial Intelligence (AI). The articles forming this volume reflect a variety of important trends, developments, and applications covering a range of current topics relating to the theory and applications of argumentation. Our aims in this introduction are, firstly, to place these contributions in the context of the historical foundations of argumentation in AI and, subsequently, to discuss a number of themes that have emerged in recent years resulting in a significant broadening of the areas in which argumentation based methods are used. We begin by presenting a brief overview of the issues of interest within the classical study of argumentation: in particular, its relationship-in terms of both similarities and important differences-to traditional concepts of logical reasoning and mathematical proof. We continue by outlining how a number of foundational contributions provided the basis for the formulation of argumentation models and their promotion in AI related settings and then consider a number of new themes that have emerged in recent years, many of which provide the principal topics of the research presented in this volume.

The Carneades model of argument and burden of proof

Volume 171, Issues 10-15, July 2007, Pages 875-896
Gordon, T.F. | Prakken, H. | Walton, D.

We present a formal, mathematical model of argument structure and evaluation, taking seriously the procedural and dialogical aspects of argumentation. The model applies proof standards to determine the acceptability of statements on an issue-by-issue basis. The model uses different types of premises (ordinary premises, assumptions and exceptions) and information about the dialectical status of statements (stated, questioned, accepted or rejected) to allow the burden of proof to be allocated to the proponent or the respondent, as appropriate, for each premise separately. Our approach allows the burden of proof for a premise to be assigned to a different party than the one who has the burden of proving the conclusion of the argument, and also to change the burden of proof or applicable proof standard as the dialogue progresses from stage to stage. Useful for modeling legal dialogues, the burden of production and burden of persuasion can be handled separately, with a different responsible party and applicable proof standard for each. Carneades enables critical questions of argumentation schemes to be modeled as additional premises, using premise types to capture the varying effect on the burden of proof of different kinds of questions.

Computing ideal sceptical argumentation

Volume 171, Issues 10-15, July 2007, Pages 642-674
Dung, P.M. | Mancarella, P. | Toni, F.

We present two dialectic procedures for the sceptical ideal semantics for argumentation. The first procedure is defined in terms of dispute trees, for abstract argumentation frameworks. The second procedure is defined in dialectical terms, for assumption-based argumentation frameworks. The procedures are adapted from (variants of) corresponding procedures for computing the credulous admissible semantics for assumption-based argumentation, proposed in [P.M. Dung, R.A. Kowalski, F. Toni, Dialectic proof procedures for assumption-based, admissible argumentation, Artificial Intelligence 170 (2006) 114-159]. We prove that the

first procedure is sound and complete, and the second procedure is sound in general and complete for a special but natural class of assumption-based argumentation frameworks, that we refer to as p-acyclic. We also prove that in the case of p-acyclic assumption-based argumentation frameworks (a variant of) the procedure of [P.M. Dung, R.A. Kowalski, F. Toni, Dialectic proof procedures for assumption-based, admissible argumentation, Artificial Intelligence 170 (2006) 114-159] for the admissible semantics is complete. Finally, we present a variant of the procedure of [P.M. Dung, R.A. Kowalski, F. Toni, Dialectic proof procedures for assumption-based, admissible argumentation, Artificial Intelligence 170 (2006) 114-159] that is sound for the sceptical grounded semantics.

If multi-agent learning is the answer, what is the question?

Volume 171, Issue 7, May 2007, Pages 365-377
Shoham, Y. | Powers, R. | Grenager, T.

The area of learning in multi-agent systems is today one of the most fertile grounds for interaction between game theory and artificial intelligence. We focus on the foundational questions in this interdisciplinary area, and identify several distinct agendas that ought to, we argue, be separated. The goal of this article is to start a discussion in the research community that will result in firmer foundations for the area.1 1This article has a long history and owes many debts. A first version was presented at the NIPS workshop, Multi-Agent Learning: Theory and Practice, in 2002. A later version was presented at the AAAI Fall Symposium in 2004 [Y. Shoham, R. Powers, T. Grenager, On the agenda(s) of research on multi-agent learning, in: AAAI 2004 Symposium on Artificial Multi-Agent Learning (FS-04-02), AAAI Press, 2004]. Over time it has gradually evolved into the current form, as a result of our own work in the area as well as the feedback of many colleagues. We thank them all collectively, with special thanks to members of the multi-agent group at Stanford in the past three years. Rakesh Vohra and Michael Wellman provided detailed comments on the latest draft which resulted in substantive improvements, although we alone are responsible for the views put forward. This work was supported by NSF ITR grant IIS-0205633 and DARPA grant HR0011-05-1.

Conjunctive and disjunctive combination of belief functions induced by nondistinct bodies of evidence

Volume 172, Issues 2-3, February 2008, Pages 234-264
Denœux, T.

Dempster's rule plays a central role in the theory of belief functions. However, it assumes the combined bodies of evidence to be distinct, an assumption which is not always verified in practice. In this paper, a new operator, the cautious rule of combination, is introduced. This operator is commutative, associative and idempotent. This latter property makes it suitable to combine belief functions induced by reliable, but possibly overlapping bodies of evidence. A dual operator, the bold disjunctive rule, is also introduced. This operator is also commutative, associative and idempotent, and can be used to combine belief functions issues from possibly overlapping and unreliable sources. Finally, the cautious and bold rules are shown to be particular members of infinite families of conjunctive and disjunctive combination rules based on triangular norms and conorms.

Combining answer set programming with description logics for the Semantic Web

Volume 172, Issues 12-13, August 2008, Pages 1495-1539
Eiter, T. | Ianni, G. | Lukasiewicz, T. | Schindlauer, R. | Tompits, H.

We propose a combination of logic programming under the answer set semantics with the description logics SHIF (D) and SHOIN (D), which underly the Web ontology languages OWL Lite and OWL DL, respectively. To this end, we introduce description logic programs (or dl-programs), which consist of a description logic knowledge base L and a finite set P of description logic rules (or dl-rules). Such rules are similar to usual rules in nonmonotonic logic programs, but they may also contain queries to L, possibly under default negation, in their bodies. They allow for building rules on top of ontologies but also, to a limited extent, building ontologies on top of rules. We define a suite of semantics for various classes of dl-programs, which conservatively extend the standard semantics of the respective classes and coincide with it in absence of a description logic knowledge base. More concretely, we generalize positive, stratified, and arbitrary normal logic programs to dl-programs, and define a Herbrand model semantics for them. We show that they have similar properties as ordinary logic programs, and also provide fixpoint characterizations in terms of (iterated) consequence operators. For arbitrary dl-programs, we define answer sets by generalizing Gelfond and Lifschitz's notion of a transform, leading to a strong and a weak answer set semantics, which are based on reductions to the semantics of positive dl-programs and ordinary positive logic programs, respectively. We also show how the weak answer sets can be computed utilizing answer sets of ordinary normal logic programs. Furthermore, we show how some advanced reasoning tasks for the Semantic Web, including different forms of closed-world reasoning and default reasoning, as well as DL-safe rules, can be realized on top of dl-programs. Finally, we give a precise picture of the computational complexity of dl-programs, and we describe efficient algorithms and a prototype implementation of dl-programs which is available on the Web.

Reasoning about preferences in argumentation frameworks

Volume 173, Issues 9-10, June 2009, Pages 901-934
Modgil, S.

The abstract nature of Dung's seminal theory of argumentation accounts for its widespread application as a general framework for various species of non-monotonic reasoning, and, more generally, reasoning in the presence of conflict. A Dung argumentation framework is instantiated by arguments and a binary conflict based attack relation, defined by some underlying logical theory. The justified arguments under different

extensional semantics are then evaluated, and the claims of these arguments define the inferences of the underlying theory. To determine a unique set of justified arguments often requires a preference relation on arguments to determine the success of attacks between arguments. However, preference information is often itself defeasible, conflicting and so subject to argumentation. Hence, in this paper we extend Dung's theory to accommodate arguments that claim preferences between other arguments, thus incorporating meta-level argumentation based reasoning about preferences in the object level. We then define and study application of the full range of Dung's extensional semantics to the extended framework, and study special classes of the extended framework. The extended theory preserves the abstract nature of Dung's approach, thus aiming at a general framework for non-monotonic formalisms that accommodate defeasible reasoning about as well as with preference information. We illustrate by formalising argument based logic programming with defeasible priorities in the extended theory.

Expressive probabilistic description logics

Volume 172, Issues 6-7, April 2008, Pages 852-883
Lukasiewicz, T.

The work in this paper is directed towards sophisticated formalisms for reasoning under probabilistic uncertainty in ontologies in the Semantic Web. Ontologies play a central role in the development of the Semantic Web, since they provide a precise definition of shared terms in web resources. They are expressed in the standardized web ontology language OWL, which consists of the three increasingly expressive sublanguages OWL Lite, OWL DL, and OWL Full. The sublanguages OWL Lite and OWL DL have a formal semantics and a reasoning support through a mapping to the expressive description logics SHIF (D) and SHOIN (D), respectively. In this paper, we present the expressive probabilistic description logics P-SHIF (D) and P-SHOIN (D), which are probabilistic extensions of these description logics. They allow for expressing rich terminological probabilistic knowledge about concepts and roles as well as assertional probabilistic knowledge about instances of concepts and roles. They are semantically based on the notion of probabilistic lexicographic entailment from probabilistic default reasoning, which naturally interprets this terminological and assertional probabilistic knowledge as knowledge about random and concrete instances, respectively. As an important additional feature, they also allow for expressing terminological default knowledge, which is semantically interpreted as in Lehmann's lexicographic entailment in default reasoning from conditional knowledge bases. Another important feature of this extension of SHIF (D) and SHOIN (D) by probabilistic uncertainty is that it can be applied to other classical description logics as well. We then present sound and complete algorithms for the main reasoning problems in the new probabilistic description logics, which are based on reductions to reasoning in their classical counterparts, and to solving linear optimization problems. In particular, this shows the important result that reasoning in the new probabilistic description logics is decidable/computable. Furthermore, we also analyze the computational complexity of the main reasoning problems in the new probabilistic description logics in the general as well as restricted cases.

On the evaluation of argumentation formalisms

Volume 171, Issues 5-6, April 2007, Pages 286-310
Caminada, M. | Amgoud, L.

Argumentation theory has become an important topic in the field of AI. The basic idea is to construct arguments in favor and against a statement, to select the "acceptable" ones and, finally, to determine whether the original statement can be accepted or not. Several argumentation systems have been proposed in the literature. Some of them, the so-called rule-based systems, use a particular logical language with strict and defeasible rules. While these systems are useful in different domains (e.g. legal reasoning), they unfortunately lead to very unintuitive results, as is discussed in this paper. In order to avoid such anomalies, in this paper we are interested in defining principles, called rationality postulates, that can be used to judge the quality of a rule-based argumentation system. In particular, we define two important rationality postulates that should be satisfied: the consistency and the closure of the results returned by that system. We then provide a relatively easy way in which these rationality postulates can be warranted for a particular rule-based argumentation system developed within a European project on argumentation.

Label ranking by learning pairwise preferences

Volume 172, Issues 16-17, November 2008, Pages 1897-1916
Hüllermeier, E. | Fürnkranz, J. | Cheng, W. | Brinker, K.

Preference learning is an emerging topic that appears in different guises in the recent literature. This work focuses on a particular learning scenario called label ranking, where the problem is to learn a mapping from instances to rankings over a finite number of labels. Our approach for learning such a mapping, called ranking by pairwise comparison (RPC), first induces a binary preference relation from suitable training data using a natural extension of pairwise classification. A ranking is then derived from the preference relation thus obtained by means of a ranking procedure, whereby different ranking methods can be used for minimizing different loss functions. In particular, we show that a simple (weighted) voting strategy minimizes risk with respect to the well-known Spearman rank correlation. We compare RPC to existing label ranking methods, which are based on scoring individual labels instead of comparing pairs of labels. Both empirically and theoretically, it is shown that RPC is superior in terms of computational efficiency, and at least competitive in terms of accuracy.

Teachable robots: Understanding human teaching behavior to build more effective robot learners

Volume 172, Issues 6-7, April 2008, Pages 716-737

Thomaz, A.L. | Breazeal, C.

While Reinforcement Learning (RL) is not traditionally designed for interactive supervisory input from a human teacher, several works in both robot and software agents have adapted it for human input by letting a human trainer control the reward signal. In this work, we experimentally examine the assumption underlying these works, namely that the human-given reward is compatible with the traditional RL reward signal. We describe an experimental platform with a simulated RL robot and present an analysis of real-time human teaching behavior found in a study in which untrained subjects taught the robot to perform a new task. We report three main observations on how people administer feedback when teaching a Reinforcement Learning agent: (a) they use the reward channel not only for feedback, but also for future-directed guidance; (b) they have a positive bias to their feedback, possibly using the signal as a motivational channel; and (c) they change their behavior as they develop a mental model of the robotic learner. Given this, we made specific modifications to the simulated RL robot, and analyzed and evaluated its learning behavior in four follow-up experiments with human trainers. We report significant improvements on several learning measures. This work demonstrates the importance of understanding the human-teacher/robot-learner partnership in order to design algorithms that support how people want to teach and simultaneously improve the robot's learning behavior.

AND/OR search spaces for graphical models

Volume 171, Issues 2-3, February 2007, Pages 73-106
Dechter, R. | Mateescu, R.

The paper introduces an AND/OR search space perspective for graphical models that include probabilistic networks (directed or undirected) and constraint networks. In contrast to the traditional (OR) search space view, the AND/OR search tree displays some of the independencies present in the graphical model explicitly and may sometimes reduce the search space exponentially. Indeed, most algorithmic advances in search-based constraint processing and probabilistic inference can be viewed as searching an AND/OR search tree or graph. Familiar parameters such as the depth of a spanning tree, treewidth and pathwidth are shown to play a key role in characterizing the effect of AND/OR search graphs vs. the traditional OR search graphs. We compare memory intensive AND/OR graph search with inference methods, and place various existing algorithms within the AND/OR search space.

On principle-based evaluation of extension-based argumentation semantics

Volume 171, Issues 10-15, July 2007, Pages 675-700
Baroni, P. | Giacomin, M.

The increasing variety of semantics proposed in the context of Dung's theory of argumentation makes more and more inadequate the example-based approach commonly adopted for evaluating and comparing different semantics. To fill this gap, this paper provides two main contributions. First, a set of general criteria for semantics evaluation is introduced by proposing a formal counterpart to several intuitive notions related to the concepts of maximality, defense, directionality, and skepticism. Then, the proposed criteria are applied in a systematic way to a representative set of argumentation semantics available in the literature, namely grounded, complete, preferred, stable, semi-stable, ideal, prudent, and CF2 semantics.

Using arguments for making and explaining decisions

Volume 173, Issues 3-4, March 2009, Pages 413-436
Amgoud, L. | Prade, H.

Arguments play two different roles in day life decisions, as well as in the discussion of more crucial issues. Namely, they help to select one or several alternatives, or to explain and justify an already adopted choice. This paper proposes the first general and abstract argument-based framework for decision making. This framework follows two main steps. At the first step, arguments for beliefs and arguments for options are built and evaluated using classical acceptability semantics. At the second step, pairs of options are compared using decision principles. Decision principles are based on the accepted arguments supporting the options. Three classes of decision principles are distinguished: unipolar, bipolar or non-polar principles depending on whether i) only arguments pros or only arguments cons, or ii) both types, or iii) an aggregation of them into a meta-argument are used. The abstract model is then instantiated by expressing formally the mental states (beliefs and preferences) of a decision maker. In the proposed framework, information is given in the form of a stratified set of beliefs. The bipolar nature of preferences is emphasized by making an explicit distinction between prioritized goals to be pursued, and prioritized rejections that are stumbling blocks to be avoided. A typology that identifies four types of argument is proposed. Indeed, each decision is supported by arguments emphasizing its positive consequences in terms of goals certainly satisfied and rejections certainly avoided. A decision can also be attacked by arguments emphasizing its negative consequences in terms of certainly missed goals, or rejections certainly led to by that decision. Finally, this paper articulates the optimistic and pessimistic decision criteria defined in qualitative decision making under uncertainty, in terms of an argumentation process. Similarly, different decision principles identified in multiple criteria decision making are restated in our argumentation-based framework.

Laying the foundations for a World Wide Argument Web

Volume 171, Issues 10-15, July 2007, Pages 897-921
Rahwan, I. | Zablith, F. | Reed, C.

This paper lays theoretical and software foundations for a World Wide Argument Web (WWAW): a large-scale Web of inter-connected arguments posted by individuals to express their opinions in a structured manner.

First, we extend the recently proposed Argument Interchange Format (AIF) to express arguments with a structure based on Walton's theory of argumentation schemes. Then, we describe an implementation of this ontology using the RDF Schema Semantic Web-based ontology language, and demonstrate how our ontology enables the representation of networks of arguments on the Semantic Web. Finally, we present a pilot Semantic Web-based system, ArgDF, through which users can create arguments using different argumentation schemes and can query arguments using a Semantic Web query language. Manipulation of existing arguments is also handled in ArgDF: users can attack or support parts of existing arguments, or use existing parts of an argument in the creation of new arguments. ArgDF also enables users to create new argumentation schemes. As such, ArgDF is an open platform not only for representing arguments, but also for building interlinked and dynamic argument networks on the Semantic Web. This initial public-domain tool is intended to seed a variety of future applications for authoring, linking, navigating, searching, and evaluating arguments on the Web.

Negotiating with bounded rational agents in environments with incomplete information using an automated agent

Volume 172, Issues 6-7, April 2008, Pages 823-851
Lin, R. | Kraus, S. | Wilkenfeld, J. | Barry, J.

Many tasks in day-to-day life involve interactions among several people. Many of these interactions involve negotiating over a desired outcome. Negotiation in and of itself is not an easy task, and it becomes more complex under conditions of incomplete information. For example, the parties do not know in advance the exact tradeoff of their counterparts between different outcomes. Furthermore information regarding the preferences of counterparts might only be elicited during the negotiation process itself. In this paper we propose a model for an automated negotiation agent capable of negotiating with bounded rational agents under conditions of incomplete information. We test this agent against people in two distinct domains, in order to verify that its model is generic, and thus can be adapted to any domain as long as the negotiators' preferences can be expressed in additive utilities. Our results indicate that the automated agent reaches more agreements and plays more effectively than its human counterparts. Moreover, in most of the cases, the automated agent achieves significantly better agreements, in terms of individual utility, than the human counterparts playing the same role.

Audiences in argumentation frameworks

Volume 171, Issue 1, January 2007, Pages 42-71
Bench-Capon, T.J.M. | Doutre, S. | Dunne, P.E.

Although reasoning about what is the case has been the historic focus of logic, reasoning about what should be done is an equally important capacity for an intelligent agent. Reasoning about what to do in a given situation-termed practical reasoning in the philosophical literature-has important differences from reasoning about what is the case. The acceptability of an argument for an action turns not only on what is true in the situation, but also on the values and aspirations of the agent to whom the argument is directed. There are three distinctive features of practical reasoning: first, that practical reasoning is situated in a context, directed towards a particular agent at a particular time; second, that since agents differ in their aspirations there is no right answer for all agents, and rational disagreement is always possible; third, that since no agent can specify the relative priority of its aspirations outside of a particular context, such prioritisation must be a product of practical reasoning and cannot be used as an input to it. In this paper we present a framework for practical reasoning which accommodates these three distinctive features. We use the notion of argumentation frameworks to capture the first feature. An extended form of argumentation framework in which values and aspirations can be represented is used to allow divergent opinions for different audiences, and complexity results relating to the extended framework are presented. We address the third feature using a formal description of a dialogue from which preferences over values emerge. Soundness and completeness results for these dialogues are given.

Anyone but him: The complexity of precluding an alternative

Volume 171, Issues 5-6, April 2007, Pages 255-285
Hemaspaandra, E. | Hemaspaandra, L.A. | Rothe, J.

Preference aggregation in a multiagent setting is a central issue in both human and computer contexts. In this paper, we study in terms of complexity the vulnerability of preference aggregation to destructive control. In particular, we study the ability of an election's chair to, through such mechanisms as voter/candidate addition/suppression/partition, ensure that a particular candidate (equivalently, alternative) does not win. And we study the extent to which election systems can make it impossible, or computationally costly (NP-complete), for the chair to execute such control. Among the systems we study-plurality, Condorcet, and approval voting-we find cases where systems immune or computationally resistant to a chair choosing the winner nonetheless are vulnerable to the chair blocking a victory. Beyond that, we see that among our studied systems no one system offers the best protection against destructive control. Rather, the choice of a preference aggregation system will depend closely on which types of control one wishes to be protected against. We also find concrete cases where the complexity of or susceptibility to control varies dramatically based on the choice among natural tie-handling rules.

MEBN: A language for first-order Bayesian knowledge bases

Volume 172, Issues 2-3, February 2008, Pages 140-178
Laskey, K.B.

Although classical first-order logic is the de facto standard logical foundation for artificial intelligence, the lack

of a built-in, semantically grounded capability for reasoning under uncertainty renders it inadequate for many important classes of problems. Probability is the best-understood and most widely applied formalism for computational scientific reasoning under uncertainty. Increasingly expressive languages are emerging for which the fundamental logical basis is probability. This paper presents Multi-Entity Bayesian Networks (MEBN), a first-order language for specifying probabilistic knowledge bases as parameterized fragments of Bayesian networks. MEBN fragments (MFrags) can be instantiated and combined to form arbitrarily complex graphical probability models. An MFrag represents probabilistic relationships among a conceptually meaningful group of uncertain hypotheses. Thus, MEBN facilitates representation of knowledge at a natural level of granularity. The semantics of MEBN assigns a probability distribution over interpretations of an associated classical first-order theory on a finite or countably infinite domain. Bayesian inference provides both a proof theory for combining prior knowledge with observations, and a learning theory for refining a representation as evidence accrues. A proof is given that MEBN can represent a probability distribution on interpretations of any finitely axiomatizable first-order theory.

Deterministic planning in the fifth international planning competition: PDDL3 and experimental evaluation of the planners

Volume 173, Issues 5-6, April 2009, Pages 619-668
Gerevini, A.E. | Haslum, P. | Long, D. | Saetti, A. | Dimopoulos, Y.

The international planning competition (IPC) is an important driver for planning research. The general goals of the IPC include pushing the state of the art in planning technology by posing new scientific challenges, encouraging direct comparison of planning systems and techniques, developing and improving a common planning domain definition language, and designing new planning domains and problems for the research community. This paper focuses on the deterministic part of the fifth international planning competition (IPC5), presenting the language and benchmark domains that we developed for the competition, as well as a detailed experimental evaluation of the deterministic planners that entered IPC5, which helps to understand the state of the art in the field. We present an extension of pddl, called pddl3, allowing the user to express strong and soft constraints about the structure of the desired plans, as well as strong and soft problem goals. We discuss the expressive power of the new language focusing on the restricted version that was used in IPC5, for which we give some basic results about its compilability into pddl2. Moreover, we study the relative performance of the IPC5 planners in terms of solved problems, CPU time, and plan quality; we analyse their behaviour with respect to the winners of the previous competition; and we evaluate them in terms of their capability of dealing with soft goals and constraints, and of finding good quality plans in general. Overall, the results indicate significant progress in the field, but they also reveal that some important issues remain open and require further research, such as dealing with strong constraints and computing high quality plans in metric-time domains and domains involving soft goals or constraints.

Random constraint satisfaction: Easy generation of hard (satisfiable) instances

Volume 171, Issues 8-9, June 2007, Pages 514-534
Xu, K. | Boussemart, F. | Hemery, F. | Lecoutre, C.

In this paper, we show that the models of random CSP instances proposed by Xu and Li [K. Xu, W. Li, Exact phase transitions in random constraint satisfaction problems, Journal of Artificial Intelligence Research 12 (2000) 93-103; K. Xu, W. Li, Many hard examples in exact phase transitions with application to generating hard satisfiable instances, Technical report, CoRR Report cs.CC/0302001, Revised version in Theoretical Computer Science 355 (2006) 291-302] are of theoretical and practical interest. Indeed, these models, called RB and RD, present several nice features. First, it is quite easy to generate random instances of any arity since no particular structure has to be integrated, or property enforced, in such instances. Then, the existence of an asymptotic phase transition can be guaranteed while applying a limited restriction on domain size and on constraint tightness. In that case, a threshold point can be precisely located and all instances have the guarantee to be hard at the threshold, i.e., to have an exponential tree-resolution complexity. Next, a formal analysis shows that it is possible to generate forced satisfiable instances whose hardness is similar to unforced satisfiable ones. This analysis is supported by some representative results taken from an intensive experimentation that we have carried out, using complete and incomplete search methods.

Algorithms for the coalitional manipulation problem

Volume 173, Issue 2, February 2009, Pages 392-412
Zuckerman, M. | Procaccia, A.D. | Rosenschein, J.S.

We investigate the problem of coalitional manipulation in elections, which is known to be hard in a variety of voting rules. We put forward efficient algorithms for the problem in Borda, Maximin and Plurality with Runoff, and analyze their windows of error. Specifically, given an instance on which an algorithm fails, we bound the additional power the manipulators need in order to succeed. We finally discuss the implications of our results with respect to the popular approach of employing computational hardness to preclude manipulation.

Positive approximation: An accelerator for attribute reduction in rough set theory

Volume 174, Issues 9-10, June 2010, Pages 597-618
Qian, Y.H. | Liang, J.Y. | Pedrycz, W. | Dang, C.Y.

Feature selection is a challenging problem in areas such as pattern recognition, machine learning and data mining. Considering a consistency measure introduced in rough set theory, the problem of feature selection, also called attribute reduction, aims to retain the discriminatory power of original features. Many heuristic

attribute reduction algorithms have been proposed however, quite often, these methods are computationally time-consuming. To overcome this shortcoming, we introduce a theoretic framework based on rough set theory, called positive approximation, which can be used to accelerate a heuristic process of attribute reduction. Based on the proposed accelerator, a general attribute reduction algorithm is designed. Through the use of the accelerator, several representative heuristic attribute reduction algorithms in rough set theory have been enhanced. Note that each of the modified algorithms can choose the same attribute reduct as its original version, and hence possesses the same classification accuracy. Experiments show that these modified algorithms outperform their original counterparts. It is worth noting that the performance of the modified algorithms becomes more visible when dealing with larger data sets.

Practical reasoning as presumptive argumentation using action based alternating transition systems

Volume 171, Issues 10-15, July 2007, Pages 855-874
Atkinson, K. | Bench-Capon, T.

In this paper we describe an approach to practical reasoning, reasoning about what it is best for a particular agent to do in a given situation, based on presumptive justifications of action through the instantiation of an argument scheme, which is then subject to examination through a series of critical questions. We identify three particular aspects of practical reasoning which distinguish it from theoretical reasoning. We next provide an argument scheme and an associated set of critical questions which is able to capture these features. In order that both the argument scheme and the critical questions can be given precise interpretations we use the semantic structure of an Action-Based Alternating Transition System as the basis for their definition. We then work through a detailed example to show how this approach to practical reasoning can be applied to a problem solving situation, and briefly describe some other previous applications of the general approach. In a second example we relate our account to the social laws paradigm for co-ordinating multi-agent systems. The contribution of the paper is to provide firm foundations for an approach to practical reasoning based on presumptive argument in terms of a well-known model for representing the effects of actions of a group of agents.