

07431 Abstracts Collection
Computational Issues in Social Choice
— **Dagstuhl Seminar** —

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Abstract. From .. to .., the Dagstuhl Seminar 07431 “Computational Issues in Social Choice” was held in the International Conference and Research Center (IBFI), Schloss Dagstuhl. During the seminar, several participants presented their current research, and ongoing work and open problems were discussed. Abstracts of the presentations given during the seminar as well as abstracts of seminar results and ideas are put together in this paper. The first section describes the seminar topics and goals in general. Links to extended abstracts or full papers are provided, if available.

Keywords. To be done

Selection Games and Deterministic Lotteries

Alon Altman (Stanford University, USA)

The design of deterministic and fair mechanisms for selection among a set of self-motivated agents based solely on these agents’ input is a major challenge for electronic commerce. These mechanisms are a special case of zero-sum games where the only possible outcomes are selections of a single agent among the set of agents. We assume the lack of an external coordinator, and therefore we focus on mechanisms which have a solution where the agents play weakly dominant strategies. Our first major result shows that dominated strategies could be added to any selection mechanism, so that the resulting mechanism becomes quasi-symmetric. For fairness, we require the mechanism to be non-imposing; that is, the mechanism should allow any agent to be selected in such a solution. We first show that such mechanisms do not exist when there are two or three agents in the system. However, surprisingly, we show that such mechanisms exist when

there are four or more agents. Moreover, in our second major result, we show that there exist selection mechanisms that implement any distribution over the agents, when the agents play mixed dominant strategies.

These results also have significance for distributed computing, ranking systems, and social choice.

Keywords: Multiagent lottery selection game

Joint work of: Altman, Alon; Tennenholtz, Moshe

A Distributed Platform for Mechanism Design

Krzysztof Apt (CWI - Amsterdam, NL)

We describe design of a structured, highly flexible platform for distributed mechanism design. In our approach the players dynamically form a network in which they know neither their neighbours nor the size of the network and interact to jointly take decisions. The only assumption concerning the underlying communication primitive is that for each pair of players there is a path connecting them. This allows us to deal with arbitrary network topologies.

The design is implemented in Java and yields a distributed system.

It can be used for a repeated creation of dynamically formed networks of players interested in a joint decision making implemented by means of a taxed-based mechanism. The system is built as a sequence of layers. The lower layers deal with the operations relevant for distributed computing, while the upper layers are concerned with communication between players, including broadcasting and multicasting, and distributed decision making.

Specific applications are realized as instances of the top layer.

The flexibility of the resulting platform is illustrated by a number of examples.

Joint work with Farhad Arbab and Huiye Ma.

Keywords: Mechanism design, distributed implementation

Weighted voting games: computation, design and link with reliability theory

Haris Aziz (University of Warwick, GB)

Weighted voting games are ubiquitous mathematical models which are used in economics, political science, neuroscience, threshold logic, reliability theory and distributed systems. They model situations where agents with variable voting weight vote in favour of or against a decision. A coalition of agents is winning if and only if the sum of weights of the coalition exceeds or equals a specified quota. The Banzhaf index is a measure of voting power of an agent in a weighted voting game. It depends on the number of coalitions in which the agent is the difference in the coalition winning or losing. I examine voting power theory and weighted voting games from a computational point of view. It is pointed out how weighted voting games and simple games provide a link between social choice theory and reliability theory. An efficient algorithm for designing weighted voting games is then presented. The latter is joint work with Mike Paterson and Dennis Leech.

Keywords: Weighted Voting Games, computational social choice, voting power, Banzhaf index, reliability theory, distributed systems and algorithms

Parameterized Computational Complexity of Dodgson and Young Elections

Nadja Betzler (Universität Jena, D)

We show that, other than for standard complexity theory, the computational (in)tractability of the classic Dodgson and Young election systems behaves very differently from a parameterized complexity point of view. That is, on the one hand, we present an efficient fixed-parameter algorithm for determining a Condorcet winner in Dodgson elections by a minimum number of switches in the votes. On the other hand, we prove that the corresponding problem for Young elections, where one has to delete votes instead of performing switches, is $W[2]$ -complete. In addition, we study Dodgson elections that allow ties between the candidates and give fixed-parameter tractability as well as $W[2]$ -hardness results depending on the cost model for switching ties.

Keywords: Fixed-parameter tractability, $W[2]$ -completeness, voting/election systems

Joint work of: Betzler, Nadja; Guo, Jiong; Rolf Niedermeier

Efficiency and envy-freeness in fair division of indivisible goods: logical representation and complexity

Sylvain Bouveret (ONERA - Toulouse, F)

We consider the problem of allocating fairly a set of indivisible goods among agents from the point of view of compact representation and computational complexity. We start by assuming that agents have dichotomous preferences expressed by propositional formulae. We express efficiency and envy-freeness in a logical setting, which reveals unexpected connections to nonmonotonic reasoning. Then we identify the complexity of determining whether there exists an efficient and envy-free allocation, for several notions of efficiency, when preferences are represented in a succinct way (as well as restrictions of this problem). We first study the problem under the assumption that preferences are dichotomous, and then in the general case.

Keywords: Fair division, complexity, envy-freeness, compact representation, preferences

Joint work of: Bouveret, Sylvain; Lang, Jérôme

The Computational Complexity of Tournament Solutions

Felix Brandt (LMU München, D)

Various problems in the mathematical social sciences can be tackled by finding the “most desirable” elements of a set given some binary relation. Examples can be found in areas as diverse as social choice theory, game theory, and argumentation theory. We review the computational complexity of a number of solution concepts—so-called tournament solutions—ranging from von Neumann-Morgenstern stable sets to the Banks set. Some particularly attractive solution concepts are defined in terms of a *covering* relation—a transitive subrelation of the original relation. We consider three different types of covering (upward, downward, and bidirectional) and the corresponding solution concepts known as the *uncovered set* and the *minimal covering set*. We present the first polynomial-time algorithm for finding the minimal bidirectional covering set (an acknowledged open problem) and prove that deciding whether an alternative is in a minimal upward or downward covering set is NP-hard. Furthermore, we obtain various set-theoretical inclusions, which reveal a strong connection between von Neumann-Morgenstern stable sets and upward covering on the one hand, and the Banks set and downward covering on the other hand. In particular, we show that every stable set is also a minimal upward covering set.

Joint work of: Brandt, Felix; Fischer, Felix

False-Name-Proofness in Social Choice, and Limited Verification of Identities

Vincent Conitzer (Duke University, USA)

A mechanism is false-name-proof if no agent can benefit from using multiple identifiers (e.g. e-mail addresses). We show that the best false-name-proof voting rule satisfying participation is to draw two alternatives at random; if all votes prefer the same one, choose that one, otherwise flip a coin. To address this and other impossibility results, we show how to verify the identities of some agents so that the mechanism and the verification protocol together are false-name-proof.

Keywords: Voting, social choice, false-name-proofness, identity verification

An ultrafilter proof of an impossibility result in judgment aggregation

Daniel Eckert (Universität Graz, A)

The ultrafilter proof strategy familiar from social choice theory is applied to prove a typical impossibility result in judgment aggregation.

Keywords: Judgment aggregation; ultrafilter; decisive sets; social choice; simple games

Computational Complexity of Weighted Voting Games

Edith Elkind (University of Liverpool, GB)

Weighted voting games are coalitional games in which each player has a weight (intuitively corresponding to its voting power), and a coalition is successful if the sum of its weights exceeds a given threshold. Key questions in coalitional games include finding coalitions that are stable (in the sense that no member of the coalition has any rational incentive to leave it), and finding a division of payoffs to coalition members (an imputation) that is fair.

We investigate the computational complexity of such questions for weighted voting games. We study the *core*, the *least core*, and the *nucleolus*, distinguishing those problems that are polynomial-time computable from those that are NP-hard, and providing pseudopolynomial and approximation algorithms for the NP-hard problems.

Joint work of: Elkind, Edith; Goldberg, Leslie Ann; Goldberg, Paul; Wooldridge, Michael

Some of my current interests in computational social choice ...

Ulle Endriss (University of Amsterdam, NL)

(My talk at Dagstuhl will be on the third of the topics listed below.)

I currently have several interests falling under the broad heading of Computational Social Choice, including the following:

(1) A long-standing interest (pursued together with Nicolas Maudet, Yann Chevaleyre, and others) has been the study of protocols for fair division that allow agents to find an optimal allocation in a distributed and interactive manner. A central theme here are so-called convergence theorems, which identify conditions under which a sequence of local negotiation steps can be guaranteed to eventually converge to a socially optimal state, but we have also investigated complexity issues and carried out computer simulations.

The AAAI-2007 paper cited below is a recent example for this line of work. It discusses convergence to an envy-free state when agents are constrained by a graph defining who can "see" which other agents. The graph restricts both who agents can make deals with and which other agents they may envy.

(2) A second line of research is concerned with the analysis of (in particular logic-based) languages for representing preferences. For collective-decision making problems, a succinct representation of the preferences of the individual decision-makers is crucial when the number of alternatives is large, as is the case in combinatorial domains (e.g. committee elections or resource allocation problems with indivisible goods). The AiPref-2007 paper with Joel Uckelman, for instance, studies languages based on weighted propositional formulas to model utility functions. We are interested in the expressive power of different such languages, in their relative succinctness, and in the computational complexity of related decision and optimisation problems.

(3) The TARK-2007 paper cited below is about manipulation in approval voting. It shows that there are several interesting scenarios in approval voting in which no voter has an incentive to vote by means of an insincere ballot. This is possible (and does not contradict the Gibbard-Satterthwaite Theorem) because in approval voting there are multiple ways of voting sincerely for any given preference ordering. The approach taken in the paper is, at least partly, computational in the sense that some of the results have been derived with the help of a computer.

Y. Chevaleyre, U. Endriss, and N. Maudet.

Allocating Goods on a Graph to Eliminate Envy.

Proc. 22nd AAAI Conference on Artificial Intelligence (AAAI-2007).

J. Uckelman and U. Endriss.

Preference Representation with Weighted Goals: Expressivity, Succinctness, Complexity.

Proc. AAAI Workshop on Preference Handling for Artificial Intelligence (AiPref-2007).

U. Endriss.

Vote Manipulation in the Presence of Multiple Sincere Ballots.

Proc. 11th Conference on Theoretical Aspects of Rationality and Knowledge (TARK-2007).

Distributed Algorithms for Social Choice

Boi Faltings (EPFL, CH)

We consider social choice problems consisting of interrelated sets of variables controlled by different agents.

Distributed algorithms are desirable for three reasons. First, agents can set their variables to reasonable values even if optimization is incomplete, thus improving the reliability of the process. Second, agents do not need to formalize their preferences for variables they control, thus avoiding potentially huge efforts of preference elicitation.

Third, agents can maintain privacy of many aspects of their preferences.

I describe distributed optimization algorithms and how they can be extended to satisfy incentive compatibility and privacy requirements in social choice.

Keywords: Constraint optimization, constraint satisfaction

Dominance in Social Choice and Coalitional Game Theory

Paul Harrenstein (LMU München, D)

We consider dominance relations for social choice as based on the pairwise majority rule on the one hand and cooperative games with non-transferable utility (coalitional NTU games) on the other. As these dominance relations may fail to be transitive and even contain cycles, the notion of maximality becomes untenable as an analytical tool. Both in social choice theory and cooperative game theory, a number of concepts have been proposed to take over the role of maximality in the absence of transitivity. In 1953 McGarvey showed that any irreflexive and anti-symmetric relation can be obtained by the majority rule. In this paper, we address the analogous issue for finite NTU games. We find *any* irreflexive relation over a finite set can be obtained as the dominance relation of some ordinary, monotonic, and simple NTU coalitional game. We also show that any dominance relation can be induced by a *non-cooperative* game via beta-effectivity. Furthermore, we obtain a partial result for the case in which alpha-effectivity is used and consider the formal interrelationships between Smith sets, Schwartz sets, stable sets and the core in finite NTU games.

Keywords: Dominance solutions, Coalitional Game Theory, NTU, Social Choice

Joint work of: Harrenstein, Paul; Brandt, Felix

Llull and Copeland Voting Broadly Resist Bribery and Control

Edith Hemaspaandra (Rochester Institute of Technology, USA)

Control of elections refers to attempts by an agent to, via such actions as addition/deletion/partition of candidates or voters, ensure that a given candidate wins [BTT92]. An election system in which such an agent’s computational task is NP-hard is said to be resistant to the given type of control. Among election systems with polynomial-time winner determination problems, the only election systems known to be resistant to all the standard control types are highly artificial election systems created by hybridization [HHR07].

In this paper, we prove that an election system developed by the 13th century mystic Ramon Llull and the well-studied Copeland election system are both resistant to all the standard types of (constructive) electoral control other than one variant of addition of candidates.

This is the most comprehensive resistance to control yet achieved by any natural election system. In addition, we show that Llull and Copeland voting are very broadly resistant to bribery attacks, and we integrate the potential irrationality of voter preferences into many of our results.

Joint work of: Faliszewski, Piotr; Hemaspaandra, Edith; Hemaspaandra, Lane; Rothe, Joerg

Sequential voting in multi-issue domains

Jerome Lang (IRIT - Toulouse, F)

In many real-world group decision making problems, the set of alternatives is a Cartesian product of finite value domains for each of a given set of variables (or issues). Dealing with such domains leads to the following well-known dilemma: either ask the voters to vote separately on each issue, which may lead to so-called multiple election paradoxes as soon as voters’ preferences are not separable; or allow voters to express their full preferences on the set of all combinations of values, which is practically impossible as soon as the number of issues and/or the size of the domains are more than a few units. We try to reconcile both views and find a middle way, by relaxing the extremely demanding separability restriction into this much more reasonable one: there exists a linear order $i_1 > \dots >_{p}$ on the set of issues such that for each voter, every issue i_j is preferentially independent of i_{j+1}, \dots, i_p given i_1, \dots, i_{j-1} . This leads us to define a family of sequential voting rules, defined as the sequential composition of local voting rules. These rules relate to the setting of conditional preference networks (CP-nets) recently developed in the Artificial Intelligence literature. Lastly, we study in detail how these sequential rules inherit, or do not inherit, the properties of their local components.

Keywords: Voting; combinatorial domains; multiple elections; preferential independence; CP-nets

Joint work of: Lang, Jerome; Xia, Lirong

Representing interval orders by weighted bases: some complexity results

Pierre Marquis (Université d'Artois - Lens, F)

This work is centered on the notion of interval order as a model for preferences. We introduce a family of representation languages for such orders, parameterized by a scale and an aggregation function. We show how interval orders can be represented by elements of those languages, called weighted bases. We identify the complexity of the main decision problems to be considered for exploiting such representations of interval orders (including the comparison problems and the non-dominance problem). We also show that the representation of interval orders based on weighted bases encompasses the penalty-based representation of complete preorders as a specific case.

Keywords: Compact representation of preferences; Preferences over combinatorial domains; Computational complexity;

Joint work of: Marquis, Pierre; Öztürk, Meltem;

Topological Issues in Multiagent Resource Allocation Problems

Nicolas Maudet (Université Paris-Dauphine, F)

Resource allocation is a typical social choice problem which consists in allocating (optimally) a set of resources to a number of agents. We present recent results and discuss issues pertaining to the topological structure of negotiation/communication graphs, when allocations are iteratively and locally negotiated by autonomous agents, in a truly distributed manner. (This is joint work with Yann Chevaleyre and Ulle Endriss)

Full Paper:

[2 http://www.lamsade.dauphine.fr/maudet/pubs/ChevaleyreEndrissMaudetAAAI.pdf](http://www.lamsade.dauphine.fr/maudet/pubs/ChevaleyreEndrissMaudetAAAI.pdf)<http://www.lamsade.dauphine.fr/maudet/pubs/ChevaleyreEndrissMaudetAAAI.pdf>

See also: Yann Chevaleyre, Ulle Endriss, and Nicolas Maudet. Allocating Goods on a Graph to Eliminate Envy. In Proceedings of the 22nd AAAI Conference on Artificial Intelligence (AAAI-2007), pp. 700–705, AAAI Press, July 2007.

Determining winners in weighted and unweighted sequential majority voting

Maria Silvia Pini (Università di Padova, I)

In sequential majority voting, preferences are aggregated by a sequence of pairwise comparisons (also called an agenda) between candidates. The result of each comparison is determined by a weighted majority vote between the agents. In this paper we consider the situation where the agents may not have revealed all their preferences. This is common in real-life settings, due to privacy issues or an ongoing elicitation process. We study the computational complexity of determining the winner(s), given that some preferences may not yet be revealed and the agenda is not yet known or decided. We show that it is easy to determine if a candidate must win whatever the agenda. On the other hand, it is hard to know whether a candidate can win in at least one agenda for at least one completion of unrevealed preferences. This is also true if the agenda is balanced (that is, each candidate must win the same number of pairwise competitions to win overall). We also consider the case of fixed agendas. We show that in this case it is easy to determine if a candidate can win in the fixed agenda for at least a completion or for every completion of unrevealed preferences.

Keywords: Sequential Majority Voting , Multiagent Systems, Uncertainty

Joint work of: Pini, Maria Silvia; Rossi, Francesca; Venable, Kristen Brent; Walsh, Toby

Algorithms for the Coalitional Manipulation Problem

Ariel D. Procaccia (The Hebrew University of Jerusalem, IL)

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 Scoring rules, 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.

Joint work with Michael Zuckerman and Jeffrey S. Rosenschein.

Joint work of: Zuckerman, Michael; Procaccia, Ariel D.; Rosenschein, Jeffrey S.

See also: To appear in SODA'08.

Using graphical utility models for multi-issue bargaining and preference elicitation

Valentin Robu (CWI - Amsterdam, NL)

The first part of the talk will cover our work on using utility graphs for modeling bilateral negotiations between agents with k -additive utility functions. Multi-issue negotiation with non-linear utilities represents a considerably more challenging problem than the widely studied case of linearly additive utilities, since potentially complex complementarity/substitutability dependencies between issues must be taken into account. We show, through algorithmic analysis and experimental evaluation, that our proposed graphical utility formalism enables agents to reach agreements that are close to Pareto-efficiency, with a limited number of negotiation steps.

We apply the proposed negotiation model to the e-commerce domain, in which agents bargain about the contents of bundles of items, where the utility functions of the buyers can be represented in k -additive form. In this setting, we complement our negotiation algorithm with a method to approximate the initial, starting structure of buyer utility graph, based on anonymous negotiation data. The construction of the maximal graph structure is based on techniques inspired from item-based collaborative filtering, used in online recommendation algorithms. We show that this combined method enables electronic agents to achieve fast agreements in complex negotiations, by focusing the search on the most promising region of the high-dimensional utility space. (joint work with Koye Somefun, Han La Poutre)

The second part of the talk briefly covers the use of collaborative filtering techniques (initially developed by us in the above context of multi-issue negotiation) to construct tag correlation graphs using empirical data, in a collaborative tagging application (joint work with Harry Halpin, Edinburgh and Hana Shepherd, Princeton). Finally, we will discuss, very briefly, some ideas for ongoing work regarding the application of graphical utility models to preference elicitation in k -additive domains.

References:

V. Robu, D.J.A. Somefun, and J. A. La Poutre. Modeling complex multi-issue negotiations using utility graphs. In Proc. of the 4th Int. Conf. on Autonomous Agents Multi Agent Systems (AAMAS'05), Utrecht, ACM Press, 2005.

V. Robu and J. A. La Poutre. Retrieving the structure of utility graphs used in multi-item negotiation through collaborative filtering of aggregate buyer preferences. In 2nd Int. Workshop on Rational, Robust and Secure Negotiations in Multi-Agent Syst. (RRSS'06), Hakodate, Japan. (Springer LNCS, to appear 2008).

Halpin, H., Robu, V., Shepherd, H. "The Complex Dynamics of Collaborative Tagging", Proceedings of the 16th Int. World Wide Web Conference (WWW'07), Banff, Canada, ACM Press, 2007.

Keywords: Negotiation, bargaining, multi-issue negotiation, k -additive utilities, utility graphs, collaborative filtering, multi-agent systems, intelligent agents

Approximating Optimal Weighted Lobbying

Jörg Rothe (Universität Düsseldorf, D)

Christian et al. (COMSOC 2006) showed that optimal lobbying is intractable in the sense of parameterized complexity. In this talk, an efficient greedy algorithm is presented that achieves a logarithmic approximation ratio for this problem and even for a more general variant—optimal weighted lobbying. We prove that essentially no better approximation ratio than ours can be proven for this greedy algorithm.

Keywords: Optimal weighted lobbying; approximation; greedy algorithm

Joint work of: Erdélyi, Gábor; Hemaspaandra, Lane; Rothe, Jörg; Spakowski, Holger

Full Paper:

[2 http://www.springerlink.com/content/k17158742477j513/http://www.springerlink.com/content/k17158742477j513](http://www.springerlink.com/content/k17158742477j513/http://www.springerlink.com/content/k17158742477j513)

See also: Gábor Erdélyi, Lane A. Hemaspaandra, Jörg Rothe, Holger Spakowski: On Approximating Optimal Weighted Lobbying, and Frequency of Correctness Versus Average-Case Polynomial Time. FCT 2007: 300-311

Clearing Algorithms for Barter Exchange Markets: Enabling Nationwide Kidney Exchanges

Tuomas Sandholm (CMU - Pittsburgh, USA)

In barter-exchange markets, agents seek to swap their items with one another, in order to improve their own utilities. These swaps consist of cycles of agents, with each agent receiving the item of the next agent in the cycle. We focus mainly on the upcoming national kidney-exchange market, where patients with kidney disease can obtain compatible donors by swapping their own willing but incompatible donors. With over 70,000 patients already waiting for a cadaver kidney in the US, this market is seen as the only ethical way to significantly reduce the 4,000 deaths per year attributed to kidney disease.

The clearing problem involves finding a social welfare maximizing exchange when the maximum length of a cycle is fixed. Long cycles are forbidden, since, for incentive reasons, all transplants in a cycle must be performed simultaneously. Also, in barter-exchanges generally, more agents are affected if one drops out of a longer cycle. We prove that the clearing problem with this cycle-length constraint is NP-hard. Solving it exactly is one of the main challenges in establishing a national kidney exchange.

We present the first algorithm capable of clearing these markets on a nationwide scale. The key is incremental problem formulation. We adapt two paradigms

for the task: constraint generation and column generation. For each, we develop techniques that dramatically improve both runtime and memory usage. We conclude that column generation scales drastically better than constraint generation. Our algorithm also supports several generalizations, as demanded by real-world kidney exchanges.

Our algorithm replaced CPLEX as the clearing algorithm of the Alliance for Paired Donation, one of the leading kidney exchanges. The match runs are conducted every two weeks and transplants based on our optimizations have already been conducted.

www.cs.cmu.edu/~sandholm/kidneyExchange.EC07.withGrantInfo.pdf

Keywords: Matching market, exchange, clearing algorithm, winner determination, computational complexity

Joint work of: Abraham, David; Blum, Avrim; Sandholm, Tuomas;

Full Paper:

[2 http://www.cs.cmu.edu/~sandholm/kidneyExchange.EC07.withGrantInfo.pdf](http://www.cs.cmu.edu/~sandholm/kidneyExchange.EC07.withGrantInfo.pdf)<http://www.cs.cmu.edu/~sandholm/kidneyExchange.EC07.withGrantInfo.pdf>

Proportional Representation and Strategic Voters

Arkadii Slinko (University of Auckland, NZ)

The goal of this paper is to examine the incentives to vote insincerely, other than those created by rounding, faced by voters in the systems of proportional representation (PR). We rigorously investigate two models of voter behaviour. The first model assumes that a voter is primarily interested in the distribution of seats in the post-election parliament (seat maximiser) while the second considers a voter who is concerned with the distribution of power in it (power maximiser).

We show that under pure PR seat maximisers do not have any incentives to manipulate, which justifies the Bowler and Lanoue (1992) claim, and that such incentives for seat maximisers appear with the introduction of a threshold.

We show that, even in the absence of a threshold, there will always exist circumstances where a power maximiser would have an incentive to vote insincerely. We demonstrate that her incentives to make an insincere vote depend on her attitude toward uncertainty. The introduction of a threshold creates new and stronger opportunities for strategic voters regardless their attitude towards uncertainty. Finally we discuss the overshooting/undershooting phenomenon, when either too many or too few like-minded voters attempt to manipulate.

We use two models to explain voters' behaviour at the most recent (2005) New Zealand general election and demonstrate that rounding creates not only incentives but also disincentives for strategic voting.

Keywords: Parliament choosing rule, proportional representation, power index, strategic voting, manipulability, overshooting, undershooting

Joint work of: Slinko, Arkadii; White, Shaun

On the link between Social Choice and Multiple Criteria Decision Analysis

Alexis Tsoukias (Université Paris-Dauphine, F)

In this talk I survey the several relations between Social Choice Theory and Multiple Criteria Decision Analysis. I first show the conceptual similarities between the two theories and how these have been developed in the past 30 years as an alternative to the mainstream multi-attribute value theory. I will also explore the critical differences between Social Choice and MCDA with particular emphasis to concepts such as weights, trade-offs, importance of coalitions and measures. The talk will also survey more recent results in the literature where the differences between preference aggregation procedures are revisited under conjoint measurement theory (work done by D. Bouyssou and M. Pirlot). Current research directions will conclude the presentation.

Keywords: Multiple Criteria Decision Analysis, Social Choice Theory

Full Paper:

[2 http://www.springer.com/france/home/generic/search/results?SGWID=7-40109-22-116132747-0SHORTCUT=www.springer.com/sgw/cda/frontpage/0,11855,7-40109-22-116132747-0,00.html](http://www.springer.com/france/home/generic/search/results?SGWID=7-40109-22-116132747-0SHORTCUT=www.springer.com/sgw/cda/frontpage/0,11855,7-40109-22-116132747-0,00.html)<http://www.springer.com/france/home/generic/search/results?SGWID=7-40109-22-116132747-0SHORTCUT=www.springer.com/sgw/cda/frontpage/0,11855,7-40109-22-116132747-0,00.html>

See also: D. Bouyssou, Th. Marchant, M. Pirlot, A. Tsoukias, Ph. Vincke, Evaluation and Decision Models: Stepping Stones for the Analyst, Springer Verlag, Berlin, 2006.

A Family of Logic-Based Preference Representation Languages and an Application to Combinatorial Auctions

Joel Uckelman (University of Amsterdam, NL)

Logic-based preference representation languages can be useful when agent preferences are over combinatorial domains—for example, possible committees in committee elections, or bundles of goods in combinatorial auctions—situations in which it can be challenging simply to convey agent preferences due to the large number of possible outcomes.

Logic-based languages have a number of appealing properties, among them that

- 1) natural syntactic constraints (i.e., on the kinds of propositional formulas agents are allowed to use) are closely related to properties of utility functions, and so these languages can be tailored to express particular classes of utility functions, and

2) the structure of these languages is useful in answering queries about agent preferences.

In a paper presented at AiPref-2007, Ulle Endriss and I explore the expressive power, succinctness of representation, and complexity of finding maximal states for several logic-based languages. Recent work has involved comparing branch-and-bound heuristics for the Winner Determination Problem for combinatorial auctions where bidders use a logic-based language for bidding. Our heuristics attempt to exploit the structure of the language when solving the WDP.

J. Uckelman and U. Endriss.

Preference Representation with Weighted Goals: Expressivity, Succinctness, Complexity. Proc. AAI Workshop on Preference Handling for Artificial Intelligence (AiPref-2007).

Notions of optimality in CP-nets, strategic games and soft constraints

Brent Venable (Università di Padova, I)

The notion of optimality naturally arises in many areas of applied mathematics and computer science concerned with decision making. Here we consider this notion in the context of three formalisms used for different purposes in reasoning about multi-agent systems: strategic games, CP-nets, and soft constraints. To relate the notions of optimality in these formalisms we introduce a natural qualitative modification of the notion of a strategic game.

We show then that the optimal outcomes of a CP-net are exactly the Nash equilibria of an appropriately defined strategic game. This allows us to use the techniques of game theory to search for optimal outcomes of CP-nets and vice-versa, to use techniques developed for CP-nets to search for Nash equilibria of the considered games. Then, we relate the notion of optimality used in the area of soft constraints to that used in strategic games, showing that, for a class of soft constraints that includes weighted constraints, every optimal solution is a Nash equilibrium. However, the notion that coincides in general with optimality for soft constraints is that of Pareto efficient joint strategy.

Keywords: Strategic games, pure Nash equilibria, preferences, CP nets, soft constraints

Joint work of: Apt, Krzysztof R.; Rossi, Francesca; Venable, Brent;

Voting with partial orders

Lirong Xia (Duke University, USA)

Voters are not always able to give a complete linear order of the alternatives, either because they are unable to compare certain alternatives, or because the set of alternatives is too large. Hence, we study the case where voters submit partial orders (possibly represented as a CP-net). We show several impossibility results regarding neutrality and Pareto efficiency for such voting rules/correspondences; introduce a voting correspondence that can be applied even when there is no relation among the submitted CP-nets; and study the complexity of determining whether an alternative will win for some/any completion of the partial orders, given a standard voting rule.

Joint work of: Xia, Lirong; Conitzer, Vincent; Lang, Jerome

Voting with the mean and with the (spatial) median: decisiveness and manipulability

William S. Zwicker (Union College - Schenectady, USA)

What do the following voting systems have in common?

*Approval voting *Borda count *Kemeny rule *Typical grading systems that assign a letter grade for a course based on the average of several test scores.

Each is a mean proximity rule; each has a representation in which inputs (votes) are identified with points in Euclidean space, and the results of the election are determined by the output point \hat{T} closest (in the Euclidean metric) to the mean location q of the votes.

We show that the mean proximity rules coincide with the mean polygonal rules, and with a (highly) generalized class of scoring rules.

The mean affine rules represent a further generalization. We show that the rational mean affine rules are exactly the voting rules that are consistent and connected.

This is a sort of generalization of Smith's and Young's results characterizing scoring rules, but in a broader context, with no use of a neutrality axiom.

What happens when we substitute for the mean q , in these representations, the mediancentre (Fermat-Weber point) mc , a multidimensional version of the median? We obtain a new and rather strange class of voting rules with some interesting and different properties. For example, the $\$McBorda$ rule \hat{T} is more resistant to manipulation than the Borda rule, and much more decisive (fewer ties).

The mediancentre presents us with some computational challenges, particularly when it is located on or near a segment boundary (the election is tied, or close to tied). I could use some advice on these algorithmic questions, especially in the case of median rules for many voters, or for more than 3 alternatives.

See the pictures in the extended version of this abstract, which I have uploaded.

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Keywords: Mean rule, generalized scoring rule, mean affine rule, Fermat-Weber point, mediancentre, decisiveness, manipulability

Joint work of: Zwicker, William S.

Social Software for Coalition Formation

Harrie de Swart (Tilburg University, NL)

This paper concerns an interdisciplinary approach to coalition formation. We apply the MacBeth software, relational algebra, the RelVieW tool, graph theory, bargaining theory, social choice theory, and consensus reaching to a model of coalition formation. A feasible government is a pair consisting of a coalition of parties and a policy supported by this coalition. A feasible government is stable if it is not dominated by any other feasible government. Each party evaluates each government with respect to certain criteria.

MacBeth helps to quantify the importance of the criteria and the attractiveness and repulsiveness of governments to parties with respect to the given criteria. Feasibility, dominance, and stability are formulated in relation-algebraic terms. The RelVieW tool is used to compute the dominance relation and the set of all stable governments. In case there is no stable government, i.e., in case the dominance relation is cyclic, we apply graph-theoretical techniques for breaking the cycles. If the solution is not unique, we select the final government by applying bargaining or appropriate social choice rules. We describe how a coalition may form a government by reaching consensus about a policy.

Keywords: Coalition formation; stable government; MacBeth; relational algebra; RelVieW; graph theory

Joint work of: Rusinowska, Agnieszka; Berghammer, Rudolf; Eklund, Patrik; van der Rijt, Jan-Willem; Roubens, Marc; de Swart, Harrie;

See also: Harrie de Swart, e.a. (eds.), Theory and Applications of Relational Structures as Knowledge Instruments II, Springer, LNAI 4342, 1-30

Sheets Social Software for Coalition Formation

Harrie de Swart (Tilburg University, NL)

The Model of Coalition Formation.

Applying the MacBeth Technique.

Applying RelVieW

Applying Graph Theory

Joint work of: Rusinowska, Agnieszka; Berghammer, Rudolf; Eklund, Patrik; van der Rijt, Jan-Willem; Roubens, Marc; de Swart, Harrie;

Reasoning about Coalitional Games

Wiebe van der Hoek (University of Liverpool, GB)

The area of Logic and Games roughly has two directions: Games for Logic, in which one for instance tries to give a game-theoretically inspired truth definition, or a notion of similarity of models, and Logic for Games, where one takes a representational, computational and proof-theoretic view on games. The talk will be an example of the latter branch. Until now, this branch is typically exploited by Modal Logicians, modeling phenomena in non-cooperative games. In this talk, we make a first step in formalising reasoning in coalitional, or cooperative games. We present two logics that facilitate reasoning about such games: the first is expressively complete, whereas the second can deal with infinitely many outcomes of a coalitional game.

Keywords: Coalitional Games

Joint work of: Agotnes, Thomas; van der Hoek, Wiebe; Wooldridge, Michael