Report from Dagstuhl Seminar 13231

Belief Change and Argumentation in Multi-Agent Scenarios

Edited by

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Abstract

This report documents the programme and outcomes of Dagstuhl Seminar 13231 "Belief Change and Argumentation in Multi-Agent Scenarios". The seminar brought together researchers from the fields of argumentation theory and belief revision, both from philosophy and computer science, to present recent research results and exchange ideas for combining argumentation and belief revision. A key objective of the seminar, moreover, has been to shed light on the applicability of these two fields in the area of multi-agent systems: Can both argumentation and belief revision be combined and used in a rational agent? Before revising its beliefs, how should an agent decide *what*, or *what part of the new information* should be believed? Can this deliberation before the proper revision process be performed by argumentation?

The unique atmosphere of Dagstuhl provided again a perfect environment for leading researchers from a wide variety of backgrounds to discuss future directions of argumentation, belief revision and their applications in multi-agent systems.

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1 Executive Summary

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Belief change and argumentation theory both belong to the wide field of knowledge representation, but their focal points are different. Argumentation theory provides frameworks for reasoning by setting up formal structures that allow the processing and evaluation of arguments for or against a certain option. Here, focus is put on dialectical deliberation and on finding justifications for decisions. Belief change theory has its focus on the adjustments of previously held beliefs that are needed in such processes. However, the interrelations between the two fields are still for the most part unexplored.

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Both the fields of argumentation theory and belief revision are of substantial relevance for multi-agent systems which are facing heavy usage in industrial and other practical applications in diverse areas, due to their appropriateness for realizing distributed autonomous systems. Moreover, the topics of this seminar address recent research questions in the general area of decision making and are innovative in the combination of methods.

The seminar took place June 3rd–7th 2013, with 39 participants from 16 countries. The program included overview talks, individual presentations by the participants and group discussions. Overview talks ranged from 30 to 35 minutes, individual presentations were about 25 minutes long, including questions. We specifically asked participants not to present current research (their next conference paper), but rather asked to relate their research to argumentation/belief revision and how it could be used in agent theories.

Participants were encouraged to use their presentations to provide input for the discussion groups. We organized two discussion groups that each met twice (they took place in the afternoon, before and after the coffee break). Each group was headed by two organizers as discussion leaders (see Section 4).

The seminar concluded with the presentation of the group discussions on Friday morning and a wrap-up of the seminar.

From the discussion groups, some core topics arose which will help to focus further scientific work: Semantical issues concerning belief revision and argumentation were seen to be of major importance, and a layered view on both argumentation and belief revision, separating the underlying logic from the argumentation layer resp. revision layer helped to provide common grounds for the two communities. Both these topics proved to be very successful to stimulate scientific discourse, gave rise to interesting questions that might lead to papers and projects in the future, and look promising to allow a deeper analysis and a better understanding of the links between the two areas. Furthermore, a strong interest in having more applications and benchmarks became obvious, and a road map collecting informations on that is planned.

The organizers agreed to put together a special issue of *Annals of Mathematics and Artificial Intelligence* on *Argumentation and Belief revision* and invite papers on the use of methods and tools from belief change theory in argumentation theory, on the use of methods and tools from argumentation theory in belief change theory, on systems and frameworks that contain elements from both belief change and argumentation, and on practical applications of argumentation or belief revision in multi-agent systems or knowledge representation.

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3 Overview of Talks

3.1 Pareto Optimality and Strategy Proofness in Group Argument Evaluation

Edmond Awad (Masdar Institute – Abu Dhabi, AE)

Joint work of Edmond Awad, Mikolaj Podlaszewski, Martin Caminada, Gabriella Pigozzi

Collective argument evaluation is the problem of aggregating multiple opinions about how a given set of arguments should be evaluated. However, finding a consistent collective evaluation might not be the only concern. Two key criteria, to consider, are Pareto optimality and strategy proofness, which are fundamental in any social choice and multi-agent setting. Two aggregation operators were studied with respect to Pareto optimality and strategy proofness. However, these studies were built on naive models of preferences. In this study, we propose more realistic types of preferences and use them to study three operators from literature with respect to Pareto optimality and strategy proofness.

3.2 On the Maximal and Average Numbers of Stable Extensions

Ringo Baumann (Universität Leipzig, DE)

Joint work of Baumann, Ringo; Strass, Hannes
Main reference R. Baumann, H. Strass, "On the Maximal and Average Numbers of Stable Extensions," in Proc. of the Second Int'l Workshop on Theory and Applications of Formal Argumentation (TAFA'13), Aug. 2013.

We present an analytical and empirical study of the maximal and average numbers of stable extensions in abstract argumentation frameworks. As one of the analytical main results, we prove a tight upper bound on the maximal number of stable extensions that depends only on the number of arguments in the framework. More interestingly, our empirical results indicate that the distribution of stable extensions as a function of the number of attacks in the framework seems to follow a universal pattern that is independent of the number of arguments.

The obtained results can be used to provide lower bounds for the minimal realizibility of certain sets of extensions. Furthermore, counting techniques may yield upper bounds for algorithms computing extensions. Finally, the average number gives some guidance on how many extensions a given AF with n arguments and m attacks will have.

3.3 Changes driven by goals in argumentation: Framework and tool

Pierre Bisquert (Paul Sabatier University – Toulouse, FR)

Joint work of Bisquert, Pierre; Dupin de St-Cyr, Florence; Cayrol, Claudette; Lagasquie, M.C.

This work defines a new framework for dynamics in argumentation. In this framework, an agent can change an argumentation system (the target system) in order to achieve some desired goal. Changes consist in addition/removal of arguments or attacks between arguments. The agent must respect some constraints induced by her own knowledge encoded by another argumentation system. We present a software that computes the possible change operations for a given agent on a given target argumentation system in order to achieve some given goal.

3.4 Toward a Constructive Theory of Epistemic Change

Alexander Bochman (Holon Institute of Technology, IL)

We discuss some directions and desiderata for the development of a constructive theory of epistemic change, paying special attention to the representation problem of distributed knowledge, as well as the relationships of belief change to inference and argumentation.

3.5 Argumentation as Inference vs Argumentation as Dialogue

Martin Caminada (University of Aberdeen, GB)

Joint work of Caminada, Martin; Podlaszewski, Mikołaj
Main reference M. Caminada, M. Podlaszewski, "Grounded Semantics as Persuasion Dialogue," in Proc. of Computational Models of Arguments (COMMA'12), Frontiers in Artificial Intelligence and Applications, Vol. 245, pp. 478–485, IOS Press, 2012.
URL http://dx.doi.org/10.3233/978-1-61499-111-3-478
URL http://homepages.abdn.ac.uk/martin.caminada/pages/publications/COMMA_grounded_game.pdf

In the formal argumentation community, one can distinguish two main lines of research: argumentation as inference and argumentation as dialogue. The first line of research, going back to the work of Pollock, Vreeswijk and Simari & Loui, is focused on argumentation as a way of performing non-monotonic entailment. That is, it is focused on the *outcome* of argumentation. The second line of research, going back to the work of Hamblin, Mackenzie and Walton & Krabbe, is focused on argumentation as dialectics, involving different parties. That is, it is focused on the *process* of argumentation.

In our recent work, we aim to reconcile these two lines of research. In particular, we are able to express argument-based entailment as the ability to win a particular type of discussion.

3.6 Enforcement in Argumentation is a kind of Update

Florence Dupin de St-Cyr (Paul Sabatier University – Toulouse, FR)

Joint work of Bisquert, Pierre; Cayrol, Claudette; Dupin de Saint-Cyr, Florence; Lagasquie-Schiex, Marie-Christine
Main reference P. Bisquert, C. Cayrol, F. Dupin de Saint-Cyr, M.-C. Lagasquie-Schiex, "Enforcement in Argumentation is a kind of Update," in Proc. of the 7th Int'l Conf. on Scalable Uncertainty Management (SUM'13), Washington DC, USA, September 16 to 18, 2013.
URL http://www.irit.fr/publis/ADRIA/PapersDupin/Draftsum2013.pdf

In the literature, enforcement consists in changing an argumentation system in order to force it to accept a given set of arguments. In this paper, we extend this notion by allowing incomplete information about the initial argumentation system. Generalized enforcement is an operation that maps a propositional formula describing a system and a propositional formula that describes a goal, to a new formula describing the possible resulting systems. This is done under some con- straints about the allowed changes. We give a set of postulates restraining the class of enforcement operators and provide a representation theorem linking them to a family of proximity relations on argumentation systems.

3.7 Potential knowledge

Andre Fuhrmann (Goethe-Universität Frankfurt am Main, DE)

The thesis that every truth is knowable is usually glossed by decomposing knowability into possibility and knowledge. Under elementary assumptions about possibility and knowledge, considered as modal operators, the thesis collapses the distinction between truth and knowledge (as shown by the so-called Fitch-argument). As far as a purely logical refutation of the knowability thesis comes as a surprise, the Fitch-argument is paradoxical.—We show that there is a more plausible way of interpreting knowability such that the Fitch-argument does not apply. In this interpretation possibility acts not as a modal operator but as a modal modifier of a modal operator. We call this the potential knowledge-interpretation of knowability. We compare our interpretation with the rephrasal of knowability proposed by Edgington and Rabinowicz & Segerberg, inserting an actuality-operator. This proposal shares some key features with ours but suffers from requiring specific transworld-knowledge. We observe that potential knowledge involves no transworld-knowledge. We describe the logic of potential knowledge by providing a new type of models, hyperrelational models, for interpreting the new operator. Finally we show that potential knowledge cannot be fitched: The knowability thesis can be added to the elementary logic of potential knowledge without collapsing modal distinctions.

3.8 Identity Merging and Identity Revision in Talmudic Logic

Dov Gabbay (King's College London, GB)

Let K be a classical monadic theory (let us call it the *Surface* theory) and let a and b be two constants. The theory might say $P(a) \wedge \neg P(b)$. Suppose we add the identity input $a = b$. We get inconsistency. Ordinary AGM revision will do whatever it does to restore consistency. AGM is not adequate in normative legal context

However, the legal system of the Talmud does it differently. It will ask , where do $P(a)$ and $\neg P(b)$ come from (i.e. how are they derived from other basic principles; why do we have them in the theory?) and once we know that we can decide which one of the two to choose. So we need to assume the existence of another *deep* theory , from which the sentence of the *surface* theory are derived non-monotonically. With each surface monadic predicate $P(c)$ we associate a deep base theory $\Delta[P(c)]$ which derives either $P(c)$ or $\neg P(c)$. When we revise by $a = b$, we look at $\Delta[P(a)] \cup \Delta[P(b)]$. This theory might prove different results, being non-monotonically more specific. For example take the recent Boston marathon terrorist problem. The law deals one way with the rights of terrorists and allows sending them to a prison camp $P(a)$ and another way with the rights of american citizens, not allowing sending them to prison camp $\neg P(b)$. How to deal with entities which are both? (i.e deal with the input $a = b$?) We ask why do we have $P(a)$? The answer is that there is the deep theory of *security of the nation*. Why do we have $\neg P(b)$? The answer is that there is the deep theory of *human rights*. Taking the union of these two deep theories and see what we can derive.

This model is *good for legal reasoning* but is not adequate for Talmudiic reasoning. To model Talmudic legal reasoning we need to use logics with defeaters or reactive cancellations. Both $\neg P(a)$ and $\neg P(b)$ can be derived but security cancels the negation $\neg P(a)$, and we end up with $P(a) \wedge \neg P(b)$. When we have the input $a = b$, then the security cancellation the negation $\neg P(a)$ is itself cancelled and we end up with $\neg P(a) \wedge \neg P(b)$. So we need a non monotonic theory of reactive cancellations of any level which can be used to implement revision of the form $x = y$.

3.9 Mixed-initiative argumentation and Arguing with optimization norms

Aditya K. Ghose (University of Wollongong, AU)

Main reference A.K. Ghose, B.T.R. Savarimuthu, "Norms as Objectives: Revisiting Compliance Management in Multi-Agent Systems," in Proc. of the 14th Int'l Workshop on Coordination, Organisations, Institutions and Norms (COIN'12), LNCS, Vol.7756, pp. 105–122, Springer, 2012.
URL http://dx.doi.org/10.1007/978-3-642-37756-3_7
Main reference C. Fon Chang, A.K. Ghose, A. Miller, "Mixed-initiative argumentation: A framework for justification management in clinical group decision support," in Proc. of the AAAI 2009 Fall Symp. on the Uses of Computational Argument, AAAI, 2009.
URL http://aaai.org/ocs/index.php/FSS/FSS09/paper/view/982
Main reference C. Fon Chang, A. Miller, A.K. Ghose, "Mixed-Initiative Argumentation: Group Decision Support in Medicine," in Proc. of the Second Int'l ICST Conf. on Eletronic Healthcare (eHealth'09), Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering, Vol. 27, pp. 43–50, Springer, 2010.
URL http://dx.doi.org/10.1007/978-3-642-11745-9_8

In the first part of this talk, I will explore a novel integration of belief revision and argumentation in the following setting. Imagine a series of rounds of argumentation where, say, a

group of experts bring to bear the same body of knowledge (as represented by the arguments they articulate and the preferences they apply) to a sequence of decisions. It is important to ensure that this body of knowledge (and in particular the set of preferences) is consistently applied in this sequence of decisions. This is also important in decision *forensics*, where this decision sequence is audited to identify errors or inconsistencies. Imagine the ability to *invert* the conventional argumentation machinery so that we are able to present a set of *winning* arguments and ask how the background theory (the set of arguments and preferences that have been brought to bear in prior decisions) might be minimally modified so that the resulting theory would generate this precise set of arguments as the winning arguments. This machinery has been implemented in a system called JUST-CLINICAL and used in clinical quality assurance in settings where specialist oncologists argue over the best course of treatment for a patient. I will also use this talk to draw attention to other applications of such an approach, including, most importantly, the design of normative frameworks for multi-agent institutions (both electronic and otherwise).

In the second part of the talk, I will offer some preliminary results on the problem of arguing with optimization norms.

3.10 An input/output perspective on abstract argumentation in a dynamic environment

Massimiliano Giacomin (University of Brescia, IT)

Joint work of Baroni, Pietro; Boella, Guido; Cerutti, Federico; Giacomin, Massimiliano; Van Der Torre, Leendert; Villata, Serena
Main reference P. Baroni, G. Boella, F. Cerutti, M. Giacomin, L. Van Der Torre, S. Villata, "On input/output argumentation frameworks ", in Proc. of Computational Models and Arguments (COMMA'12), Frontiers in Artificial Intelligence and Applications, Vol. 245, pp. 358–365, IOS Press, 2012.
URL http://dx.doi.org/10.3233/978-1-61499-111-3-358

This talk considers the interaction between argumentation-based intelligent autonomous agents in a dynamic environment, by focusing on their characterization in terms of input/output systems. More specifically, each agent can be modelled as a Dung's partial argumentation framework exposing a well- defined external interface. Two relevant questions are: i) whether the justification status of arguments according to a given semantics can be determined on the basis of local computations on partial argumentation frameworks, and ii) whether subframeworks with the same input/output behavior can be interchanged without affecting the result of semantics evaluation of the other arguments interacting with them. In order to answer the first question, the notion of semantics decomposability is introduced and the main admissibility-based semantics are analyzed in this respect. In order to answer the second question, the talk introduces Argumentation Multipoles to characterize the behavior of an argumentation framework as a black box, and studies the interchangeability of equivalent Argumentation Multipoles under admissibility-based semantics. Some applications of these results, including the study of dynamic frameworks, are finally outlined.

3.11 Belief change for finite minds

Sven Ove Hansson (KTH Stockholm, SE)

Standard models of belief change such as partial meet contraction operate by making choices among cognitively inaccessible objects such as possible worlds or maximal consistent subsets that lack a finite representation. Finite belief bases avoid that difficulty, but bring in others. An alternative approach is presented in which changes take place on finitely representable belief sets but no distinction is made between different belief bases for the same belief set. Reference to infinite objects is avoided by changing the level of selection. Choice functions can operate directly on the set of possible outcomes (the credible and reachable finite-based belief sets) rather than on infinite and cognitively inaccessible objects.

3.12 Logics for belief change operations: a short history of nearly everything

Andreas Herzig (Paul Sabatier University – Toulouse, FR)

Main reference Journées IAF, Aix-en-Provence, June 2013

We examine several belief change operations in the light of dynamic logic of propositional assignments DL-PA. We show that we can encode in a systematic way update and revision operators (such as Winslett's PMA operator and Dalal's revision operator) as particular DL-PA programs. This provides a syntactical update method.

3.13 A Probabilistic Approac to Modelling Uncertain Logical Arguments

Anthony Hunter (University College London, GB)

Main reference A. Hunter, "A probabilistic approach to modelling uncertain logical arguments," Int'l Journal of Approximate Reasoning, 54(1):47–81, 2013.
URL http://dx.doi.org/10.1016/j.ijar.2012.08.003

Argumentation can be modelled at an abstract level using a directed graph where each node denotes an argument and each arc denotes an attack by one argument on another. Since arguments are often uncertain, it can be useful to quantify the uncertainty associated with each argument. Recently, there have been proposals to extend abstract argumentation to take this uncertainty into account. This assigns a probability value for each argument that represents the degree to which the argument is believed to hold, and this is then used to generate a probability distribution over the full subgraphs of the argument graph, which in turn can be used to determine the probability that a set of arguments is admissible or an extension. In order to more fully understand uncertainty in argumentation, in this paper, we extend this idea by considering logic-based argumentation with uncertain arguments. This is based on a probability distribution over models of the language, which can then be used to give

a probability distribution over arguments that are constructed using classical logic. We show how this formalization of uncertainty of logical arguments relates to uncertainty of abstract arguments, and we consider a number of interesting classes of probability assignments.

3.14 On the Revision of Argumentation Systems: Minimal Change of Arguments Status

Sebastien Konieczny (Artois University, FR)

Joint work of Coste-Marquis, Sylvie; Konieczny, Sebastien; Mailly, Jean-Guy; Marquis, Pierre

In this work, we investigate the revision issue for argumen- tation systems a‘ la Dung. We focus on revision as minimal change of the arguments status. Contrarily to most of the previous works on the topic, the addition of new arguments is not allowed in the revision process, so that the revised system has to be obtained by modifying the attack relation, only. We introduce a language of revision formulae which is ex- pressive enough for enabling the representation of complex conditions on the acceptability of arguments in the revised system. We show how AGM belief revision postulates can be translated to the case of argumentation systems. We provide a corresponding representation theorem in terms of minimal change of the arguments status. Several distance-based revision operators satisfying the postulates are also pointed out.

3.15 Toward Incremental Computation of Argumentation Semantics: A Decomposition-based Approach

Beishui Liao (Zhejiang University, CN)

Main reference B. Liao, "Toward Incremental Computation of Argumentation Semantics: A Decomposition-based Approach," Annals of Mathematics and Artificial Intelligence, Vol. 67, Issue 3–4, pp. 319–358, 2013.
URL http://dx.doi.org/10.1007/s10472-013-9364-8

Currently, except some classes of argumentation frameworks (with special topologies or fixed parameters, such as acyclic, symmetric, and bounded tree- width, etc.) that have been clearly identified as tractable, for a generic argumentation framework (also called a defeat graph), how to efficiently compute its semantics is still a challenging problem. Inspired by the local tractability of an argumentation framework, we first propose a decomposition- based approach, and then conduct an empirical investigation. Given a generic argumentation framework, it is firstly decomposed into a set of sub-frameworks that are located in a number of layers. Then, the semantics of an argumentation framework are computed incrementally, from the lowest layer in which each sub-framework is not restricted by other sub-frameworks, to the highest layer in which each sub-framework is most restricted by the sub- frameworks located in the lower layers. In each iteration, the semantics of each sub-framework is computed locally, while the combination of semantics of a set of sub-frameworks is performed in two dimensions: horizontally and vertically. The average results show that when the ratio of the number of edges to the number of nodes of a defeat graph is less than 1.5:1, the decomposition-based approach is obviously efficient.

3.16 Argumentation and Belief Revision in Datalog+/- Ontologies Integration

Maria Vanina Martinez (University of Oxford, GB)

Joint work of Deagustini, Cristhian A. D.; Falappa, Marcelo; Simari, Guillermo R.

The increasing number of available knowledge bases in the form of ontologies accessible online makes their integration a concrete necessity in order to fully exploit the knowledge stored in these resources. While it is possible through different means to maintain a consistent ontology, it is certainly more difficult for the answers obtained separately from consistent ontologies to remain consistent when considered together. We are working towards an approach to merge multiple Datalog+/- ontologies, a family of rule-based ontological languages, addressing the incoherence and inconsistency problems related to this process.

The main idea is to develop a kernel contraction-like approach to solve conflicts in the merging process. This approach restores coherence/consistency by applying incision functions that select formulas to delete from the minimal incoherent/inconsistent sets encountered in the union of the ontologies. We wish to consider each ontology as an independent entity that represents information locally, and use that information in order to define an adequate incision function. However, in the presence of conflicts either each ontology or a set of them together can provide arguments in favor or against the different pieces of information that add up to the conflicts, and the decision of what information to remove from consideration can be identified through an argumentation process. It is therefore a principal part of this work to extend ontological languages with argumentation capabilities in order to allow ontologies (or sets of ontologies) to supply information that can be challenged and argued for and/or against in the merging process.

3.17 Reconfiguration of Large-Scale Surveillance Systems

Peter Novak (TU Delft, NL)

Joint work of Novak, Peter; Cees Witteveen

Metis project aims at study of techniques supporting development of large-scale dependable surveillance system-of-systems for maritime safety and security. Surveillance systems, such as Metis, typically comprise a number of heterogeneous information sources and information aggregators. Among the main problems of their deployment lies scalability of such systems with respect to a potentially large number of monitored entities. One of the solutions to the problem is continuous and timely adaptation and reconfiguration of the system according to the changing environment it operates in. At any given timepoint, the system should use only a minimal set of information sources and aggregators needed to facilitate cost-effective early detection of indicators of interest.

On the background of Metis prototype description, I will introduce a theoretical framework for modelling scalable information-aggregation systems. We model such systems as networks of inter-dependent reasoning agents, each representing a mechanism for justification/refutation of a conclusion derived by the agent. The algorithm facilitating continuous reconfiguration is based on standard results from abstract argumentation and corresponds to computation of a grounded extension of the argumentation framework associated with the system.

3.18 Relaxing Independence Assumption in Probabilistic Argumentation

Nir Oren (University of Aberdeen, GB)

Joint work of Li, Hengfei; Oren, Nir; Norman, Timothy J.
Main reference H. Li, N. Oren, T.J. Norman, "Relaxing Independence Assumption in Probabilistic Argumentation," in Proc. of the 10th Int'l Workshop on Argumentation in Multiagent Systems (ArgMAS'13), Saint Paul, Minnesota, USA, May 6–10 2013, 2013.
URL http://homepages.abdn.ac.uk/n.oren/pages/publications/li13relaxing.pdf

Probabilistic argumentation frameworks (PrAFs) are a novel extension to standard argumentation systems, enabling one to reason about the likelihood of a set of arguments appearing within an extension. However, PrAFs assume that the likelihood of arguments appearing is independent of the presence of other arguments. In this paper, we lift this restriction through the introduction of probabilistic evidential argumentation frameworks (PrEAFs). Our extension captures probabilistic dependencies through the use of a support relation, as used in bipolar argumentation frameworks. After describing PrEAFs and their properties, we present algorithms for computing PrEAF semantics.

3.19 System of Spheres-based Constructions of Transitively Relational Partial Meet Multiple Contractions

Mauricio Reis (University of Madeira – Funchal, PT)

Joint work of Peppas, Pavlos; Reis, Maurício D. L.; Fermé, Eduardo
Main reference E. Fermé,M.D.L. Reis, "System of spheres-based multiple contractions," Journal of Philosophical Logic, 41(1):29–52, 2012.
URL 10.1007/s10992-011-9197-z
Main reference M.D.L. Reis, "On Theory Multiple Contraction," PhD thesis, Universidade da Madeira, May 2011.
URL http://hdl.handle.net/10400.13/255

We show that not all the system of spheres-based multiple contractions (abbrev. SS-bMCs) are transitively relational partial meet multiple contractions (abbrev. TRPMMCs) and, vice versa, that not all TRPMMCs are SS-bMCs. Furthermore, we show that, contrary to what is the case in what concerns contractions by a single sentence, there is not a system of spheres-based construction of multiple contractions which originates each and every TRPMMC. Finally, we propose two ways of generalizing Grove's system of spheres-based contractions to the case of multiple contractions, which originate only TRPMMCs.

3.20 A Logical Theory about Dynamics in Abstract Argumentation

Tjitze Rienstra (University of Luxembourg, LU)

Joint work of Booth, Richard; Kaci, Souhila; Rienstra, Tjitze; van der Torre, Leendert

We address dynamics in abstract argumentation using a logical theory where an agent's belief state consists of an argumentation framework (AF, for short) and a constraint that encodes

the outcome the agent believes the AF *should* have. Dynamics enters in two ways: (1) the constraint is strengthened upon learning that the AF should have a certain outcome and (2) the AF is expanded upon learning about new arguments/attacks. A problem faced in this setting is that a constraint may be inconsistent with the AF's outcome. We discuss two ways to address this problem: First, it is still possible to form consistent *fallback beliefs*, i.e., beliefs that are most plausible given the agent's AF and constraint. Second, we show that it is always possible to find AF expansions to restore consistency. Our work combines various individual approaches in the literature on argumentation dynamics in a general setting.

3.21 Decision Making in Knowledge Integration with Dynamic Creation of Argumentation

Ken Satoh (NII – Tokyo, JP)

Joint work of Satoh, Ken; Takahashi, Kazuko
Main reference K. Satoh, K. Takahashi, "Decision Making in Knowledge Integration with Dynamic Creation of Argumentation," in Proc. of the Int'l Workshop on Information Search, Integration and Personalization (ISIP'12) / Revised Selected Papers, CCIS, Vol. 146, pp. 41–50, Springer, 2012.
URL http://dx.doi.org/10.1007/978-3-642-40140-4_5

We discuss a semantics of dynamic creation of arguments when knowledge from different agents are combined. This arises when an agent does not know the other agent's knowledge and therefore, the agent cannot predict which arguments are attacked and which counterarguments are used in order to attack the arguments. In this paper, we provide a more general framework for such argumentation system than previous proposed framework and provide a computational method how to decide acceptability of argument by logic programming if both agents are eager to give all the arguments.

3.22 Argumentation semantics and update semantics

Jan Sefranek (University of Bratislava, SK)

Main reference unpublished

A dominance of new information is an accepted feature of updates according to Katsuno-Mendelzon postulates. It is argued in this paper that new updating information could be ignored, if it depends on (defeasible) assumptions falsified by a description of a current state. This is a feature of our approach to updates of assumption-based frameworks, presented in this paper. The approach is applicable to updates of non-monotonic knowledge bases, which can be described in terms of an assumption-based framework. The updated knowledge base may be characterized semantically using different argumentation semantics. The presented framework may be applied to some types of multi-agent scenarios.Main contributions of the paper are as follows. According to our best knowledge,this is the first paper devoted to updates of assumption-based frameworks. We distinguish between preferential conflicts solving and updating. Update-solvable conflicts are defined and only those are resolved. Updating is based on sound sets of assumptions, which are not defeated by their subsets. Argumentation semantics are applied to sound sets of assumptions and admissible,maximal

admissible (preferred), stable, complete and well-founded update operations are defined. Irrelevant updates are defined and it is shown that update operations return empty set of sets of assumptions for irrelevant updates. A proposition about the inertia of a current state was proven for stable sets of assumptions. The proposition does not hold for maximal admissible(preferred) sets of assumptions, if a non-normal assumptions-based framework is given.

3.23 Probabilistic Presumption-based Argumentation with Applications to Cyber-security

Gerardo I. Simari (University of Oxford, GB)

In cyber-security applications, intelligence information and data about past attacks is often used when trying to determine the perpetrator of a specific attack of interest—this is called the "attribution problem". Knowledge bases consisting of all the information at hand are bound to contain contradictory data coming from different sources, as well as data with varying degrees of uncertainty attached. Likewise, an important aspect of this effort is deciding what information is no longer useful: intelligence reports may be outdated, may come from sources that have recently been discovered to be of low quality, or abundant evidence may be available that contradicts them. A framework capable of providing decision support in this domain must therefore be capable of: (i) handling contradictory information; (ii) answering abductive queries; (iii) managing uncertainty; and (iv) updating beliefs. Presumptions come into play as key components of answers to abductive queries, and must be maintained as elements of the knowledge base; therefore, whenever candidate answers to these queries are evaluated, the (in)consistency of the knowledge base together with the presumptions being made needs to be addressed via belief revision operations. In this talk, we describe preliminary work in the development of a probabilistic presumption-based argumentation framework to model the processes of solving attribution problems and maintaining the knowledge bases used to do so.

3.24 A (Very) Brief (and Incomplete) Overview of Argumentation Systems

Guillermo R. Simari (National University of the South – Bahia Blanca, AR)

Main reference

he research on the theoretical foundations and practical applications of Argumentation in Artificial Intelligence has been expanding at an increasingly fast pace for the last three decades. This activity has helped in the demarcation of many subareas as the investigations gained momentum, creating a field that is exciting, fruitful, and rewarding. The challenges are many, and they are met with methods and techniques that have enriched the area of Knowledge Representation and Reasoning. In this tutorial, a short structured overview of the area of Argumentation Systems will be provided in order to lay a foundation for further

discussion. We will present the intuitions and fundamentals of the process of argumentation together with a succinct introduction to abstract argumentation systems and the elements of four different of systems of concrete argumentation where arguments are constructed from a knowledge base.

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3.25 On Stratified Labelings for Argumentation Frameworks and Ranking Functions

Matthias Thimm (Universität Koblenz-Landau, DE)

Joint work of Thimm; Matthias, Kern-Isberner, Gabriele
Main reference M. Thimm, G. Kern-Isberner, "Stratified Labelings for Abstract Argumentation," Preliminary Report, arXiv:1308.0807v1 [cs.AI], 2013.
URL http://arxiv.org/abs/1308.0807v1

We introduce stratified labelings as a novel semantical approach to abstract argumentation frameworks. Compared to standard labelings, stratified labelings provide a more fine-grained assessment of the status of arguments using ranks instead of the usual labels "in", "out", and "undecided". We relate the framework of stratified labelings to conditional logic and, in particular, to the System Z ranking functions.

3.26 Possibilistic Belief Revision with Fuzzy Argumentation based on Trust

Serena Villata (INRIA Sophia Antipolis – Méditerranée, FR)

Joint work of da Costa Pereira, Celia; Tettamanzi, Andrea; Villata, Serena
Main reference C. da Costa Pereira, A. Tettamanzi, S. Villata, "Changing One's Mind: Erase or Rewind? Possibilistic Belief Revision with Fuzzy Argumentation Based on Trust," in Proc. of the 22nd Int'l Joint Conf. on Artificial Intelligence (IJCAI'11), pp. 164–171, IJCAI/AAAI, 2011.
URL http://ijcai.org/papers11/Papers/IJCAI11-039.pdf

Belief revision aims at describing the changes in the agents mind in response to new information. On the other hand, one of the important concerns in argumentation is the strategies employed by an agent in order to succeed in persuading other agents to change their

mind. In this talk, we will present our ongoing work on combining these two complementary fields of research into a unitary multi-agent framework, and we will highlight the future research lines we are pursuing. In this framework, each piece of information is represented as an argument which can be more or less accepted depending on the trustworthiness of the agent who proposes it. We adopt possibility theory to represent uncertainty about incoming information, and to model the fact that information sources can be only partially trusted. The three main ingredients of this framework are:

1. A fuzzy extension of the notion of argumentation framework, where arguments have a "strength" that depends on the trustworthiness degree of their sources;
2. A fuzzy labeling algorithm, which computes the degree of acceptability of each argument;
3. A mechanism to translate the computed fuzzy labeling into a possibilistic set of beliefs, whereby an agent will believe the conclusions of the accepted arguments, as well as their consequences.

The following are some of the advantages of such a framework: (i) partially trusted input can be taken into account naturally; (ii) arguments are never lost when contradictory information arrives; (iii) argument reinstatement is automatically mirrored in belief reinstatement; (iv) this also solves the "drowning" problem of (possibilistic) iterated belief revision.

3.27 Semantic instantiations of abstract argumentation

Emil Weydert (University of Luxembourg, LU)

Main reference Emil Weydert, "On the Plausibility of Abstract Arguments," in Proc. of the 12th Europ. Conf. on Symbolic and Quantitative Approaches to Reasoning with Uncertainty (ECSQARU'13), LNCS, Vol. 7958, pp. 522–533, Springer, 2013.
URL http://dx.doi.org/10.1007/978-3-642-39091-3_44

In recent years, the question of how to instantiate or interpret abstract argumentation frameworks, or how to justify different ways to evaluate arguments in the context of a given framework (like extension functions), has received increasing attention. Given the defeasible character of real life argumentation, arguments are instantiated in particular by defeasible inference trees or premise-conclusion pairs. However, most of these proposals have been inspired by consistency-based accounts of default reasoning which are known to violate desirable principles and benchmark examples.

The first goal of our work has therefore been to provide an alternative interpretation of abstract argumentation frameworks based on the ranking measure paradigm. Ranking measures are well-behaved (im)plausibility valuations offering a reasonable independence concept and a powerful semantics for default conditionals. They go back to Spohn's ranking functions, which he introduced to model the dynamics of graded plain belief. The idea is to associate with each framework a generic conditional knowledge base (i.e. ranking measure constraints) obtained by translating individual arguments and attack links into specific conditionals reflecting their intended meaning while minimizing informational commitments.

In a second step, we use ranking choice functions known from ranking-based default inference to pick up a natural canonical ranking model of a framework-induced default base, notably the JZ-ranking-model. System JZ appears to represent the best proxy of entropy maximization at the ranking level and satisfies many desiderata for defeasible inference. A set E of abstract arguments can be described by the conjunction of the acceptance and violation domains of those conditionals which correspond to arguments in, resp. not, in E.

The JZ-extensions are those E whose characterizing propositions are the most plausible, i.e. are ranked lowest by the JZ-ranking. The resulting extension semantics behaves as intended for many standard examples, but it fails to validate full reinstatement and diverges from all the known competitor semantics. It may be interesting to see whether recent ranking-based approaches to conditional revision can thereby also be exploited for argumentation dynamics.

To summarize, the ranking-semantic instantiation of abstract argumentation looks promising but requires further investigation.

3.28 On the Limits of Expressiveness in Abstract Argumentation Semantics

Stefan Woltran (TU Wien, AT)

Joint work of Dunne, Paul; Dvorak, Wolfgang; Linsbichler, Thomas

The study of extension-based semantics within the seminal abstract argumentation model of Dung has largely focused on definitional, algorithmic and complexity issues. In contrast, matters relating to comparisons of representational limits, in particular, the extent to which given collections of extensions are expressible within the formalism, have been underdeveloped. As such, little is known concerning conditions under which a candidate set of subsets of arguments are "realistic" in the sense that they correspond to the extensions of some argumentation framework for a semantics of interest. In this work, we present a formal basis for examining extension-based semantics in terms of the sets of extensions that these may express within a single framework and provide a number of characterization theorems which guarantee the existence of argumentation frameworks whose set of extensions satisfy specific conditions. We also discuss how our result apply to problems of belief change in argumentation and how they can be exploited in systems implementing abstract argumentation.

3.29 Argument Rejection and Acceptance Through Attack Abstractions

Zhiqiang Zhuang (Griffith University – Brisbane, AU)

We consider the dynamics of Dung's argumentation frameworks under preferred semantics. In particular, we define two operations, namely argument rejection and argument acceptance. Argument rejection changes an argument's status from accepted to rejected and argument acceptance changes an argument's status from rejected to accepted. The changes are achieved by removing a minimal number of attacks from the argumentation framework. Argument games are used in identifying such attacks.

4 Working Groups

4.1 Results of Discussion Group I – Semantical issues and models in BR and Argumentation

The following research topics have been discussed:

- Belief Revision and Argumentation as alternative approaches to model (human) reasoning – common (semantical) grounds and differences
- Using argumentation to do belief revision and belief revision as an input to the argumentation process
- Relationships between similar structures in belief revision and argumentation
- Different layers both in BR and Argumentation:
  - Relationship between underlying logic and argumentation layer resp. revision layer
  - Better understanding of the links between the two layers, and what happens under change processes
  - Bringing the meta level into the object level (and vice versa)
  - E.g., preferences need deeper knowledge, requiring argumentation?
- Find new semantics for belief revision and argumentation
- Effects of valuations on belief revision and argumentation (multi-valued logic)
- Probability in BR and Argumentation
- Ontological aspects of argumentation and belief revision
- Decomposability, local and global models
- Paraconsistent reasoning, voting, inconsistency resolution and application to belief revision
- Belief revision and argumentation in dialogue (Negotiation and belief revision); motivation / aim for approach; (dynamics and change)
- Relation between argumentation and non-monotonic reasoning
- Influence of context on belief revision and argumentation
- Argumentation and belief revision for observing / modelling real world decision making (processes) and for general applications

All's well that ends well:

- At the beginning of the discussion: "Belief revision and argumentation are as orthogonal as food and love – you need both, but they are different!"
- Towards the end of the discussion group: "Good food leads to good love!"

4.2 Results of Discussion Group II – Belief Revision and Argumentation: who can benefit how?

It is clear that Belief Revision (BR) and Argumentation (ARG) are complementarity. BR's goal is to maintain a consistent knowledge base (KB), while ARG "tolerates" an inconsistent KB by obtaining useful conclusions without changing it. The methods developed in BR for performing the work necessary to effect a revision over a KB involve an intermediate state where the KR possibly becomes inconsistent and at that point ARG could become useful. From the point of view of ARG, the tools developed to handle an inconsistent KB usually appeal to some form of dialectical analysis. The set of arguments that support the outcome of all the pieces of knowledge that are able to "survive" the dialectical analysis represents a consistent KB. Sometimes is necessary to deactivate arguments to change this outcome and at that point could be necessary to resort to the use of some BR techniques.

Regarding applications of these two formalism, the group stressed the importance of going beyond the abstract to concrete examples. Several areas where discussed; among others online debate and semantic web applications, diagnostic systems, handling trust, managing persuasion dialogues were mentioned.

There was also an interesting discussion over the possibility of maintaining a set of benchmarks to stimulate research, make meaningful the comparison between different implementations, and learn from the experimentation. Some members of the group felt that both areas lack a sufficient number of implemented systems, while others supported the idea that benchmarks could stimulate the development of those systems.

Another interesting issue in comparing the two fields was that meanwhile researchers in ARG are keenly interested in finding applications, that drive seems to be absent in the BR camp. Again this led to a discussion over the goals of combining the results of research in concrete applications.

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