Sarah A. Gaggl, Matthias Thimm (Eds.)

The Second Summer School on Argumentation: Computational and Linguistic Perspectives (SSA'16)

Proceedings

July 2016

Preface

This volume contains the thesis abstracts presented at the Second Summer School on Argumentation: Computational and Linguistic Perspectives (SSA'2016) held on September 8-12 in Potsdam, Germany. It was the second event in the series of Summer Schools on Argumentation, the first Summer School on Argumentation took place at the University of Dundee in 2014.

The main aim of the summer school was to provide attendees with a solid foundation in computational and linguistic aspects of argumentation and the emerging connections between the two. Furthermore, attendees gained experience in using various tools for argument analysis and processing.

This proceedings collects the abstracts of theses from participants of the student program of SSA'16 which consisted of a poster session, where participants could present their work and discuss it with the lecturers and keynote speakers, and a mentoring session, where specific topics related to the research in general were discussed.

July 2016

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Argumentative Reasoning, Clause Types and Implicit Knowledge

Thesis Abstract for the Second Summer School on Argumentation, 2016

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1. Clause Types and Argumentative Reasoning

Argumentation mining involves automatically identifying and structuring arguments. Informally, an argument is a discussion in which reasons (**premises**) are advanced for and against some proposition or proposal (**conclusion**) [1]. In order to detect and analyse argumentative passages within texts, we use the concept and annotation scheme of **Situation Entities** [2,3,4] which describe the semantic types of situations such as states, events, generics or habituals, evoked in discourse by individual clauses. A first case study concerning the distribution of Situation Entity (SE) types among argumentative and non-argumentative texts suggests that SE types could be helpful for modeling argumentative regions of text: we compared the distribution of SE types in the **microtext corpus** [5] - a set of prototypical argumentative texts (for an example see Fig. 1) - to a small sample of texts from other genres (fiction, reports, TED talks, and commentary (total of 266 segments)). We found that the purely argumentative microtexts are characterized by a high proportion of generic and generalizing sentences and very few events, while reports and talks, for example, contain a high proportion of states. These results point out the important role of generics within argumentative texts.

Intelligence services must urgently be regulated more tightly by parliament; this should be clear to everyone after the disclosures of Edward Snowden. Granted, those concern primarily the British and American intelligence services, but the German services evidently do collaborate with them closely. Their tools, data and expertise have been used to keep us under surveillance for a long time.

Fig. 1: Example of a microtext (micro b005)

2. First Studies: Situation Entities in Argumentative Texts

Some first investigations on the **correlations between SE types and argument components and functions** [6] support the assumption of the helpfulness of SE for identifying and modeling argumentative parts of texts. For these studies we annotated parts of the microtext corpus with SE types. The microtexts are already manually annotated according to a scheme based on Freeman's theory of the macro-structure of argumentation [7,8] that (1) contains information regarding whether an argument component is a conclusion or a premise, (2) distinguishes between premises being for or against the conclusion and (3) distinguishes between the argumentative function of premises (support, rebuttal and undercut). We matched these annotations to the Situation Entity annotations we produced. To summarize the results, the SE types correspond to the distinction between premises and conclusions - conclusions are almost exclusively either Generic Sentences or States, while premises also consist of Generalizing Sentences and Events - as well as to the distinction between premises that support a conclusion and premises that attack a conclusion (proponent premises for example contain more Generic Sentences than opponent premises). There are also interesting correlations between SE types and argumentative functions, for example the rebuttals seem to differ slightly from all of the other segments in terms of a low frequency of Generic Sentences.

3. Future Work

Although these results are based on a small dataset only and need to be confirmed by further studies, the observed tendencies could be deployed for automatic recognition and fine-grained classification of argumentative text passages. We therefore want to deploy **automatically-labeled SE types** as features for argument mining. Additionally, we will explore other features, for example the role of **modal verbs**, within this intersection of SE type and argument structure status. In order to support reasoning over argumentative texts, we will also investigate the role of unexpressed, implicit premises within arguments. In doing this, we aim to bring the fields of **Implicit Knowledge** and **Argumentative Reasoning** together.

4. Acknowledgements

For their support I want to thank Alexis Palmer, Vivi Nastase and Anette Frank.

References

[1] Marie-Francine Moens, Erik Boiy, Raquel Mochales Palau, and Chris Reed. 2007. Automatic detection of arguments in legal texts. In Proceedings of ICAIL 2007.

[2] Carlota S Smith. 2003. Modes of discourse: The local structure of texts. Cambridge University Press.

[3] Alexis Palmer, Elias Ponvert, Jason Baldridge, and Carlota Smith. 2007. A sequencing model for situation entity classification. In Proceedings of ACL.

[4] Annemarie Friedrich and Alexis Palmer. 2014. Situation entity annotation. In Proceedings of the Linguistic Annotation Workshop VIII.

[5] Andreas Peldszus and Manfred Stede. 2015. An annotated corpus of argumentative microtexts. In Proceedings of the First European Conference on Argumentation: Argumentation and Reasoned Action.

[6] Becker, Maria., Palmer, Alexis, and Frank, Anette (2016): Argumentative texts and clause types. 3rd Workshop on Argument Mining, ACL 2016.

[7] James B. Freeman. 1991. Dialectics and the Macrostructure of Argument. Foris.

[8] James B. Freeman. 2011. Argument Structure: Representation and Theory, volume 18 of Argumentation Library. Springer.

ABA$^+$: Assumption-Based Argumentation with Preferences

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Abstract. My thesis focuses on using argumentation to model common-sense reasoning with preferences. I have equipped a structured argumentation formalism, Assumption-Based Argumentation, with a preference handling mechanism. I aim to advance the newly proposed formalism, called ABA$^+$, present its place among other argumentation formalisms and discuss various properties of ABA$^+$.

Keywords. Argumentation, Preferences, Assumption-Based Argumentation

Dealing with preferences is an important topic in AI at large, and argumentation in particular. A principal issue regarding argumentation and preferences is the lack of consensus on how preferences should be accounted for. This is witnessed by a large number of argumentation formalisms handling preferences in different ways. Most of these can be broadly classified w.r.t. several main methods.

One method is to compile preferences into *the object level*, by encoding them within the existing components of an argumentation framework, such as rules. Such an approach may lead to exponential blow-up in knowledge representation and may as well be hard to generalize. Another method, utilized by numerous argumentation formalisms (see e.g. [2]) is to use preferences on *the argument level* to discard attacks from less preferred arguments: if A attacks B (written $\mathsf{A} \rightsquigarrow \mathsf{B}$) but B is preferred over A (written $\mathsf{A} < \mathsf{B}$), then $\mathsf{A} \rightsquigarrow \mathsf{B}$ fails. This may be problematic, as, for instance, $\{\mathsf{A}, \mathsf{B}\}$ could be a subset of an acceptable extension, which would then not be conflict-free w.r.t. the original attack relation (cf. [1]). Yet another approach is to employ preferences on *the extension level* to select the most 'preferable' extensions, e.g. [1]. However, this is not always adequate either: for instance, if none, or no 'intuitive' extensions (according to preferences) exist to begin with. Finally, recently proposed (Rich) Preference-based Argumentation Frameworks (PAFs) [1] employ *attack reversal* in abstract argumentation [6] setting: if $\mathsf{A} \rightsquigarrow \mathsf{B}$ and $\mathsf{A} < \mathsf{B}$, then $\mathsf{A} \rightsquigarrow \mathsf{B}$ fails and turns into $\mathsf{B} \rightsquigarrow \mathsf{A}$. Such an approach avoids a multitude of issues mentioned above.

We have taken the idea of attack reversal further, to the realm of structured argumentation, by equipping Assumption-Based Argumentation (ABA) [3,7] with (object-level) preferences over assumptions and incorporating them directly into the attack relation so as to reverse attacks. This has resulted into a new formalism, *ABA with Preferences* (ABA$^+$) [4,5], that handles preferences in structured argumentation.

In what follows, I briefly sketch the essential details of ABA$^+$, overview the progress of my research, and delineate future work directions.

An *ABA$^+$ framework* is a tuple $(\mathscr{L}, \mathscr{R}, \mathscr{A}, \bar{\ }, \leqslant)$, where: $(\mathscr{L}, \mathscr{R})$ is a deductive system; $\mathscr{A} \subseteq \mathscr{L}$ is a non-empty set of *assumptions*; $\bar{\ } : \mathscr{A} \to \mathscr{L}$ is a total *contrary* mapping;

$\leqslant$ is a transitive binary relation on $\mathscr{A}$. A *deduction for* $\varphi \in \mathscr{L}$ *supported by* $S \subseteq \mathscr{L}$ *(and* $R \subseteq \mathscr{R}$*)*, denoted by $S \vdash^R \varphi$, is a finite tree with the root labelled by φ, leaves labelled by elements from S or $\top \notin \mathscr{L}$, the children of non-leaf nodes ψ labelled by the elements of the body of some rule from $\mathscr{R}$ with head ψ, and R being the set of all such rules.

One of my major contributions is the following definition of attack in ABA$^+$. For sets $A, B \subseteq \mathscr{A}$ of assumptions, A $<$-attacks B, written $A \rightsquigarrow_< B$, just in case:

- either $\exists A' \vdash^R \overline{\beta}$, for some $\beta \in B$, supported by $A' \subseteq A$, such that $\forall \alpha' \in A' \;\; \alpha' \not< \beta$;
- or $\exists B' \vdash^R \overline{\alpha}$, for some $\alpha \in A$, supported by $B' \subseteq B$, such that $\exists \beta' \in B'$ with $\beta' < \alpha$.

ABA$^+$ semantics (as well as conflict-freeness and defence w.r.t. $\rightsquigarrow_<$) are defined as for ABA, by replacing the notion of attack with that of $<$-attack.

We have investigated and presented [4,5] various features of ABA$^+$: being a conservative extension of ABA; preserving conflicts w.r.t. the original attacks; satisfaction of rationality postulates; several preference handling principles. In terms of semantics, Fundamental Lemma and other familiar properties hold for ABA$^+$ assuming contraposition on rules. ABA$^+$ also generalizes PAFs, at the same time tackling the non-trivial task of handling object-level preferences in structured argumentation.

A handful of results regarding ABA$^+$ have now been established and are awaiting to be published. I next briefly summarize some of them, as well as the on-going work. Firstly, whereas ABA$^+$ was first restricted to the class of the so-called *flat* frameworks, I have expanded the definitions and results to non-flat frameworks too. In that setting, I have also complemented ABA$^+$ with ideal semantics, which was not previously done. Further, in terms of properties of semantics, I have advanced a weaker version of contraposition that suffices to guarantee Fundamental Lemma and familiar relations among semantics. Like its stronger variant, it concerns contrapositive reasoning, but in a preference-dependent setting, and is notably less demanding on the modification of knowledge representation. With the help of this weak notion of contraposition, I have provided means for compact graphical representations of ABA$^+$/ABA frameworks—a line of research that has attracted little attention. At the same time, I am conducting a more detailed comparison of ABA$^+$ to other formalisms of argumentation. Current results show that ABA$^+$ is genuinely different from the structured argumentation formalisms discussed in [2], and also properly generalizes PAFs [1]. I also have an undergoing project on implementation of ABA$^+$.

References

[1] Amgoud, L., Vesic, S.: Rich Preference-Based Argumentation Frameworks. International Journal of Approximate Reasoning 55(2), 585–606 (2014)

[2] Besnard, P., García, A.J., Hunter, A., Modgil, S., Prakken, H., Simari, G.R., Toni, F.: Introduction to Structured Argumentation. Argument & Computation 5(1), 1–4 (2014)

[3] Bondarenko, A., Dung, P.M., Kowalski, R., Toni, F.: An Abstract, Argumentation-Theoretic Approach to Default Reasoning. Artificial Intelligence 93(97), 63–101 (1997)

[4] Čyras, K., Toni, F.: ABA+: Assumption-Based Argumentation with Preferences. In: Baral, C., Delgrande, J.P., Wolter, F. (eds.) Principles of Knowledge Representation and Reasoning, 15h International Conference. pp. 553–556. AAAI Press, Cape Town (2016)

[5] Čyras, K., Toni, F.: Properties of ABA+ for Non-Monotonic Reasoning. In: 16th International Workshop on Non-Monotonic Reasoning. pp. 25–34. Cape Town (2016)

[6] Dung, P.M.: On the Acceptability of Arguments and its Fundamental Role in Nonmonotonic Reasoning, Logic Programming and n-person Games. Artificial Intelligence 77, 321–357 (1995)

[7] Toni, F.: A Tutorial on Assumption-Based Argumentation. Argument & Computation 5(1), 89–117 (2014)

An Automated Planning Approach for Generating Argument Dialogue Strategies

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Abstract.
Argumentation dialogues are a well established method of solving conflict in multi-agent systems. In recent years, different ways of generating effective dialogue strategies, which determine the arguments an agent should assert, have been investigated. I approach persuasion dialogues as a classical planning problem. I would like to build on the ongoing EPSRC project *Planning an Argument* (King's College London) that currently is able to find simple plans, i.e. predetermined sequences of moves irrespective of the opponent's moves. I would like to find several simple plans and then merge them into a policy to generate strategies that take the opponent's moves into consideration. I hope that this approach will scale well to larger problems.

Keywords. argumentation, planning, argument strategy

1. Introduction

In multi-agent settings, conflict can arise if agents have different view points. One way to resolve such conflicts is to engage in a persuasion dialogue. In an argumentation dialogue, each participant has a knowledge base, which is a set of arguments known to the agent. The dialogue consists of moves, i.e. utterances by the participating agents. It terminates when one participant persuades the other, or when the participants give up trying to persuade each other.

In recent years, research in this area has been concerned with finding strategies for persuasion dialogues that determine which argument the proponent should assert to its opponent, generally with the aim to maximise the probability of success. These approaches currently only scale up to 10 arguments [1,2,3].

Identifying an optimal strategy is difficult if the opponent's knowledge base is not known to the proponent and if there exists no knowledge about their expected behaviour. There are also cases where the proponent can put themselves at a disadvantage by asserting an argument that may be useful to the opponent. In my work, I assume that the proponent has some uncertain knowledge about the opponent's beliefs. This knowledge exists in terms of opponent models, i.e. possible sets of beliefs that the opponent may hold, which are associated with certain probabilities. I assume no knowledge about the opponent's strategy.

[1] Supervisors: Elizabeth Black, Amanda Coles

2. Planning Strategies for Argument Dialogues

The ongoing EPSRC project *Planning an Argument* (King's College London) is investigating the use of automated planning for generating strategies for persuasion dialogues. Like the work of Black et al. [1], the project's approach is based on treating argumentation dialogues as classical planning problems. A classical planning task consists of a set of state variables, a set of actions that are defined by preconditions and effects, and a start and a goal state. The state space is the directed graph of all states that can be reached by the application of actions. A planner can find a sequence of actions that leads from the start state to the goal state. In classical planning, only deterministic problems without uncertainty are considered.

In a persuasion dialogue, the utterances by each agent can be represented as moves. Goal states are any states where the opponent accepts a given topic.

The project is currently concerned with finding simple strategies, i.e. strategies that follow a predetermined sequence of moves rather than responding to arguments asserted by the opponent, which guarantee a certain probability of success regardless of the opponent's behaviour. This approach is not optimal, but the strategies it produces have a reasonable probability of success and it can currently cope with examples with up to 15 arguments.

I intend to increase the probability of success guaranteed by a simple strategy, in the first instance, with the following approach. Using techniques developed in the *Planning an Argument*, I will first find the simple strategy that has the highest probability of success overall, and then attempt to generate a policy by identifying branches of the dialogue where this simple strategy fails. I will then replan to find a simple strategy for these branches and merge all simple strategies into a policy. This approach can in some cases ensure success for a larger number of opponent models than a simple strategy.

The research questions I will explore in order to develop this approach are how several simple strategies can be merged into a policy that accounts for the opponent moves, how close this resulting policy is to optimality, how this approach compares to other approaches, and whether it can be adapted to deal with more complex dialogue scenarios.

3. Conclusion

I intend to use planning to find policies for persuasion dialogues by finding a simple plan that yields the highest probability of success and then identifying opponent models this plan will not succeed with. Then I want to replan using those opponent models and iteratively build a policy that covers all possible opponent models.

References

[1] E. Black; A. Coles; and S. Bernardini, Automated planning of simple persuasion dialogues, *Computational Logic in Multi-Agent Systems,* (2014), 87-104.

[2] E. Hadoux; A. Beynier; N. Maudet; P. Weng; and A. Hunter, Optimization of probabilistic argumentation with Markov decision models, *Int. Joint Conf. Artificial Intelligence,* (2015), 2004-2010.

[3] T. Rienstra; M. Thimm; and N. Oren, Opponent models with uncertainty for strategic argumentation, *IJCAI,* (2013), 332-338.

Argumentation Reasoning Tools for Online Debate Platforms

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1. Thesis Summary

An important application with great potential impact is related to debate systems that are emerging on the web. The success of these platforms in their current form seems to suggest that they can become an important source of information, just as Wikipedia is now. These debate systems are still in their infancy though. For the moment, there exists only interfaces where people can give arguments for or against a given question without any particular processing of these arguments. In the literature, only Joao Leite and Joao Martins [1] proposed a method to order arguments that applies to argumentation system where people can vote (positively and negatively) on the arguments and on the attacks.

Thus, my thesis aims to study and provide automatic reasoning/decision capabilities to these platforms. The first step consists in studying the existing ranking-based semantics defined for the Dung's abstract argumentation framework where only the arguments and the attacks are taken into consideration. The idea of these semantics is to produce a full rank-order of the arguments, from the most to the least acceptable ones contrary to the classical semantics that distinguish arguments with the accepted/rejected evaluations. Then we want to confront these different existing semantics in the classical framework based on the properties already proposed in the literature [2] and potentially propose new ones in order to characterize new families of semantics. It would also be interesting to adapt (if possible) the selected semantics to the Social Argumentation Frameworks (SAF) [1] where there are votes on the attacks and/or arguments. Finally, we plan to study the possibility to include strategies in the SAF (Does it better to add an attack, a vote ... to improve the status of an argument?) or the possibility to add others relations between arguments like the support relation for example.

2. A Comparative Study of Ranking-based Semantics

There exists several ranking semantics that allow to return a full rank-order between arguments in the literature. This is an important issue to understand their respective behaviors and the differences between them. These differences are significant since it is not difficult to find examples where all these semantics return a different ranking. So, we study the existing ranking-based semantics in the literature in the light of the proposed properties. That allows us to propose a better reading of the different choices one has on this matter. We also checked what are the properties satisfied by the usual Dung's grounded semantics, that gives some hints on the compatibility of these properties with classical semantics of Dung. For more details on the properties and the semantics, this first contribution is described in [3].

3. Define new ranking-based semantics

The previous semantics basically rely on the attacks and defenses of each argument in order to evaluate its acceptability: the less attackers and the more defenders an argument, the more acceptable the argument. However, we think that this is not the only characteristics to take into account. It is why we propose a new family of semantics, that relies on attacks and defenses, like previous semantics, but that also puts a strong emphasis on non-attacked arguments. While many principles remain discussed and controversial, all semantics agree on the fact that non-attacked arguments should have the higher rank. The idea of our semantics is that these arguments should have a great impact on the evaluation of the other ones.

So we propose six new semantics based on the idea of propagation [4]. Each argument has an initial value that depends on its status (non-attacked arguments have a greater value than attacked ones), and then these values are progressively propagated to their neighbours. Of course at each propagation the polarity of the value change in order to comply with the attack relation meaning. The difference between the semantics lies in the method that is chosen to differentiate non-attacked arguments and attacked ones, and on the choice of considering one or all paths between arguments.

4. Future Work

There is still work needed on the topic. First, we want to continue the study of recent ranking-based semantics and propose other ranking-based semantics. But it is also important to find other logical properties, and to try to characterize classes of semantics with respect to these properties. An ambitious research agenda would be to identify situations where controversial axioms are justified or not. This work on ranking-based semantics is really motivated by applications for online debates platforms. On these platforms people can usually vote on arguments and/or on attacks. So this provides weights on the arguments and on the attacks. The social argumentation framework allows to take these information into account. We started by the basic framework, without any weights. Now the plan for future work is to study the full framework, with weights on attacks and on arguments. We want to study how to generalize these semantics with weights, and which are the adaptations of the properties, or the missing one, in this case. Finally, we plan to study the possible strategic choices in the SAF or the possibility to add others relations between arguments like the support relation for example.

References

[1] J. Leite and J. Martins, "Social abstract argumentation," in *Proceedings of the 22nd International Joint Conference on Artificial Intelligence, (IJCAI'11),*, pp. 2287–2292, 2011.

[2] L. Amgoud and J. Ben-Naim, "Ranking-based semantics for argumentation frameworks," in *Proceedings of the 7th International Conference on Scalable Uncertainty Management, (SUM'13)*, pp. 134–147, 2013.

[3] E. Bonzon, J. Delobelle, S. Konieczny, and N. Maudet, "A comparative study of ranking-based semantics for abstract argumentation," in *Proceedings of the 30th Conference on Artificial Intelligence, (AAAI'16)*, pp. 914–920, 2016.

[4] E. Bonzon, J. Delobelle, S. Konieczny, and N. Maudet, "Argumentation ranking semantics based on propagation," in *6th International Conference on Computational Models of Argument, (COMMA'16)*, 2016.

Calculating rhetorical arguments strength and its application in dialogues of persuasive negotiation

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Abstract. This work addresses the problem of calculating the strength of rhetorical arguments (i.e. threats, rewards and appeals), which are used in persuasive negotiations among intelligent agents. We propose two ways for calculating the strength, depending on the kind of negotiation the agent participates. The first one is to be used when the agent negotiates only with one opponent, and the second when the agent negotiates with more than one opponent. Besides, in our model the strength calculation has to be done in two different moments: (i) before an argument is sent, this calculation is called initial, and (ii) when the proponent agent receives an answer for the argument that was sent, this calculation is called experience-based.

Keywords. rhetorical arguments, arguments strength, persuasive negotiation

1. Introduction

Persuasive negotiation involves negotiating using rhetorical arguments, which act as persuasive elements that aim to force or convince an opponent to accept a given proposal [1]. An agent involved in this kind of negotiation can generate more than one threat, reward or appeal, the question is which of these threats, rewards or appeals he will choose to persuade his opponent to accept his proposal. One way of determining this is by calculating the strength of the generated arguments, since according to Ramchurn et al. [1], a strong argument can quickly convince an opponent, while a weak argument is less persuasive. Therefore, calculating the strength of rhetorical arguments is important in persuasive negotiation dialogues, since the success and the quickness of persuasion depends on it.

Rhetorical arguments are constructed using the goals of both the proponent and the opponent(s). To measure their strength, some researchers take into account the importance of the opponent's goal and the certainty level of the beliefs that make up an argument [2,3,4]. However, besides these criteria, there are others that are necessary for a more accurate calculation. One is related to the evaluation of the quality of the opponent's goal, since it does not matter how important a goal is if it cannot be achieved, and another is the credibility execution level of the proponent (from the point of view of the opponent, i.e. credibility the proponent has in the face of his opponent(s) regarding his ability to fulfill his rewards).

2. Proposal

To deal with the goal achievability, the belief-based goal processing model proposed by Castelfranchi and Paglieri [5] is employed. It can be considered an extension of the belief-desire-intention model (BDI), but unlike it, in the Castelfranchi and Paglieri's model, the processing of goals is divided in four stages: (i) activation, (ii) evaluation, (iii) deliberation, and (iv) checking; and the states a goal can adopt are: (i) active (=desire), (ii) pursuable, (iii) chosen, and (iv) executable (=intention). The state of a goal changes when it passes from one stage to the next. Although the main part of this work is about strength calculating, the first part is devoted to an argumentation-based formalization of this model.

The proposal for the strength calculation is divided in two. On the one hand, it is taken into account the number of opponents a proponent agent has. Thus, the method for calculating the strength when the proponent has only one opponent is different than the one used when there is more than one opponent. On the other hand, it is considered the moment in which the calculation is performed. There are two different moments: (i) before an argument is sent, this calculation is called initial, and (ii) after the agent sends the argument, more precisely when the proponent agent receives an answer for the argument that was sent, this calculation is called experience-based.

The main envisaged contribution of this work is a more accurate and expressive model for calculating the strength of rhetorical arguments, which will result in a quicker and more effective persuasion process for the proponent agent.

3. Progress to date

The computational formalization of the goal processing model proposed by Castelfranchi and Paglieri is already done, however this work has not been published yet. Also, the analysis of threats and rewards has already been done. This analysis has allowed me to define different and customized formulas for calculating the strength of the arguments for each case. A short paper about threats was accepted to be published in COMMA'16.

We will continue with the analysis of appeals and the evaluation of the proposed formulas. The evaluation phase will include the definition of evaluation tools, experiments scenarios and results analysis.

References

[1] Sarvapali D Ramchurn, Nicholas R Jennings, and Carles Sierra. Persuasive negotiation for autonomous agents: A rhetorical approach. *IJCAI Workshop on Computational Models of Natural Argument*, pages 9-17, 2003.

[2] Leila Amgoud and Henri Prade. Threat, reward and explanatory arguments: generation and evaluation. In *Proceedings of the ECAI Workshop on Computational Models of Natural Argument*, pages 73-76,2004.

[3] Leila Amgoud and Henri Prade. Handling threats, rewards, and explanatory arguments in a unified setting. *International journal of intelligent systems*, 20(12):1195-1218, 2005.

[4] Leila Amgoud and Henri Prade. Formal handling of threats and rewards in a negotiation dialogue. In *Argumentation in Multi-Agent Systems*, pages 88103. Springer, 2006.

[5] Cristiano Castelfranchi and Fabio Paglieri. The role of beliefs in goal dynamics: Prolegomena to a constructive theory of intentions. *Synthese*, 155(2):237-263, 2007.

Combining Belief Revision and Abstract Dialectical Framework (ADF)

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Abstract. An important area of study in Knowledge Representation is to investigate how an agent deals with contradictory truth assertions by different entities and emerges with a coherent epistemic outcome in light of these contradictions. Belief Revision and Abstract Argumentation are two Knowledge Representation formalisms, among others, that deal with this problem. In Belief Revision, an agent is concerned with what truth assertion(s) to exclude from it's original belief state in light of a newly encountered truth assertion(s) which conflicts with it's existing belief state. Researchers have suggested many belief revision operators in literature, categorized as formula-based and model-based operators, each with a unique approach to solving the inconsistency in the belief state of an agent. Abstract Argumentation is a mechanism to arrive at a coherent result in a scenario with multiple conflicting truth assertions through examining the attacks/defend relations between them. Dung-style frameworks (AFs) are a widely studied abstract argumentation formalism. Abstract Dialectical Frameworks (ADFs) and Bipolar Abstract Dialectical Frameworks (BADFs) are generalizations of Dung-style argumentation frameworks where the acceptance of a truth assertion is dependent upon the satisfaction of an associated condition. Semantics of ADFs specify what coherent outcomes can be reached given conflicting truth assertions. In this work, we seek to find an equivalence between the process of belief revision, as defined by various belief revision operators, and syntactic and semantic dynamics of ADFs.

Keywords. Abstract Argumentation, Belief Revision, Abstract Dialectical Frameworks

1. Overview

Belief Revision is the process of determining how a new truth assertion, possibly inconsistent with an existing body of knowledge, can be incorporated into the body of knowledge to output an updated belief state which is consistent as a whole. Abstract argumentation involves striving to arrive at consistent and coherent results from among a number of conflicting truth assertions. One can identify the common dynamic between the two being that they both contain assertion of multiple truths (the propositional knowledge base consisting of multiple truth statements and the incoming truth assertion(s) in case of Belief Revision and several arguments of an argumentation framework in case of Abstract Argumentation). Similarly, the goal of both the processes is to arrive at an appropriate and coherent resolution of the respective epistemic conflicts. In case of belief revision the coherent outcome will be a *model* of the resultant knowledge base which can be thought of as an interpretation of the resultant knowledge base (including the new truth assertions(s)) which makes it wholly consistent. This may necessitate that we exclude some truth assertions contained in the original knowledge base in order to accept the new truth assertion and maintain consistency. In Abstract Argumentation, the outcome of the process can be seen as a judgment where some arguments are accepted, some others are rejected and still others can possibly be left undecided. This result is encapsulated either as extensions or labellings in case of Dung-style AFs [2] and models under *model* semantics in case of Abstract Dialectical Frameworks (ADF) [3], both of which represent arguments in the argumentation scenario which are accepted, rejected or left undecided according to a specific criterion laid down in various AF and ADF semantics.

2. Goal Statement and Methodology

'Investigate how Abstract Dialectic Frameworks (ADFs) can be used to encode a propositional logic knowledge base and a belief state. Secondly, investigate how we can use ADFs to implement belief revision operators and define equivalent ADF update operators for existing belief revision operators.

We first look at how we can encode a belief state, represented as a propositional logic knowledge base, in an ADF. We need to ensure that the models of the resultant ADF under some specific semantics coincide exactly with the models of the source knowledge base. To this end, we seek to instantiate the nodes and the attack relations between these nodes and, more importantly, the acceptance conditions associated with the nodes in such a way that the models of this instantiated ADF under a specific semantics are exactly the same as those of the source knowledge base in propositional logic.

Many belief revision operators have been defined by various authors which have been summarized succinctly by Libaratore and Schaerf in [4]. One class of operators are those which apply formula-based approach wherein they manipulate the formulas appearing in the knowledge base syntactically. Among these are the Ginsberg operator and the WIDTIO operator. Another class of operators utilize the model-based approach wherein they manipulate and operate upon the models of the existing knowledge base and the incoming information. Among these are the operators defined by Winslett, Borgida Forbus, Satoh and Dalal. Lastly, we have operators which operate on the individual variables present in the incoming piece of information. Operators defined by Hegner and Weber are among these. The vital requirement that will guide the definition of equivalent update operators in ADFs for these belief revision is that the outcomes (models) of the updated ADF, after the application of the ADF update operators, coincide exactly with the results of the belief revision operators applied to the original knowledge base.

References

[1] Alchourrón, Carlos E. , Gärdenfors, Peter and Makinson, David. 1985. On the logic of theory change: partial meet contraction and revision functions. *The Journal of Symbolic Logic*, **50**, pp. 510-530.

[2] Dung, P. M. 1995. On the acceptability of arguments and its fundamental role in non monotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, **77**, pp. 321-357.

[3] Brewka, Gerhard and Woltran, Stefan. 2010. Abstract Dialectical Frameworks. In *Proceedings of the Twelfth International Conference on the Principles of Knowledge Representation and Reasoning (KR 2010)*. pp. 102-111.

[4] Liberatore, Paolo and Schaerf, Marco. Belief Revision and Update: Complexity of Model Checking. *Journal of Computer and System Sciences*, **62(1)**, pp. 43-72.

Formal Models for the Semantic Analysis of D-BAS

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Abstract. D-BAS is a web tool for dialog-based argumentation currently under construction by members of the *NRW Fortschrittskolleg Online-Partizipation* (`http://www.fortschrittskolleg.de/`). An introductory paper [7] describing its features is accepted for presentation at COMMA 2016. Our aim is to develop formal models that are suitable to describe the system's state at a given point in time and which allow semantic analysis of it, including, but not limited to, the computation of extensions and evaluation of user positions. Current approaches include the use of abstract argumentation frameworks due to Dung [5] and the ASPIC$^+$ framework [8] for argumentation systems.

Keywords. abstract argumentation, structured argumentation, ASPIC$^+$, computational complexity, real world application

Introduction

D-BAS guides users through a discussion using an artificial, mediated dialog: a user is confronted with an argument that was created by other users and is asked to react to it by selecting from predefined options (including rebutting, undermining and undercutting attacks), thus creating a new argument. To back up this argument, the user needs to select or enter one or several natural language statements as a premise. The system will then continue the artificial dialog by, in turn, attacking this new argument.

Thus, D-BAS can be seen as a hybrid system between natural language argumentation and formal argumentation. Although atomic statements are in natural language, the logical structure lies solely in the formal arguments that connect these statements. Our aim is to provide formalizations of D-BAS that allow in-depth analysis of its properties. Challenges include the representation of all relevant aspects of a D-BAS snapshot in the models used, and finally the development of, e.g., criteria for the consistency of user positions, measures of relevance for arguments or statements given a partial user position, enforcement criteria for statements, and possible notions of manipulation.

Extending Dung Frameworks

Abstract argumentation frameworks as proposed by Dung [5] can be used to describe D-BAS snapshots at a very abstract level. Therefore, one of our objectives is to contribute

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to the development of model extensions for Dung frameworks that increase their expressivity and applicability. We provided complexity results [1] for the verification problem in argumentation frameworks with incomplete knowledge of the attack relation while other members of our group did the same for a new model with incomplete knowledge of the set of existing arguments [2]. For the future, we want to explore further model extensions and pinpoint the complexity of more decision problems in them. Currently, we work on closing the gaps in our complexity results for argumentation frameworks with incomplete knowledge.

Instantiating ASPIC⁺

We currently develop a translation of D-BAS snapshots to instances of the well-established ASPIC⁺ framework proposed by Prakken [8]. The ASPIC⁺ instantiation serves as an intermediate representation between D-BAS and Dung's abstract model. We further verified some rationality postulates for argumentation systems that were proposed in [4] for the instantiations.

Further Models

Our next steps will be to employ different frameworks for argumentation as models for D-BAS, starting with Abstract Dialectical Frameworks [3] and Carneades [6], and to compare all models by testing the plausibility of their semantic analysis results (i.e., accepted statements/arguments) using real world D-BAS snapshots. The aim is to identify one model that can serve as a theoretical model describing all of D-BAS's features, or at least identify areas of application for each model. Further steps depend on these results.

References

[1] D. Baumeister, D. Neugebauer, and J. Rothe. Verification in attack-incomplete argumentation frameworks. In *Proceedings of the 4th International Conference on Algorithmic Decision Theory*, pages 341–358. Springer-Verlag *Lecture Notes in Artificial Intelligence*, September 2015.

[2] D. Baumeister, J. Rothe, and H. Schadrack. Verification in argument-incomplete argumentation frameworks. In *Proceedings of the 4th International Conference on Algorithmic Decision Theory*, pages 359–376. Springer-Verlag *Lecture Notes in Artificial Intelligence*, September 2015.

[3] G. Brewka and S. Woltran. Abstract dialectical frameworks. In *Principles of Knowledge Representation and Reasoning: Proceedings of the Twelfth International Conference, KR 2010*. AAAI Press, 2010.

[4] Martin Caminada and Leila Amgoud. On the evaluation of argumentation formalisms. *Artificial Intelligence*, 171(5):286–310, 2007.

[5] P. Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and *n*-person games. *Artificial Intelligence*, 77(2):321–357, 1995.

[6] Thomas F Gordon, Henry Prakken, and Douglas Walton. The carneades model of argument and burden of proof. *Artificial Intelligence*, 171(10):875–896, 2007.

[7] T. Krauthoff, M. Baurmann, G. Betz, and M. Mauve. Dialog-based online argumentation. In *Computational Models of Argument: Proceedings of COMMA 2016*. IOS Press, 2016.

[8] H. Prakken. An abstract framework for argumentation with structured arguments. *Argument and Computation*, 1(2):93–124, 2010.

Synthesizing Argumentation Frameworks from Examples

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This abstract is related to my MSc thesis, to be completed by December 2016, and describes a joint work with my advisors Matti Järvisalo and Johannes Peter Wallner [1], accepted for publication in the 22nd European Conference on Artificial Intelligence (ECAI 2016).

The study of representational and computational aspects of argumentation is a core topic in modern artificial intelligence (AI) research [2]. A current strong focus of argumentation research is the extension-based setting of abstract argumentation frameworks (AFs) [3] and its generalizations. A fundamental knowledge representational aspect related to AFs is *realizability* [4], i.e., the question of whether a specific AF semantics allows for exactly representing a given set of extensions as an AF. With important motivations from various perspectives—including the analysis of the relationships of central AF semantics [4] and connections to the study of argumentation dynamics [5,6] —realizability has recently been studied by several authors.

While the study of realizability has provided various fundamental insights into AFs, the concept of realizability is quite strict in that a set E of extensions is considered realizable if and only if there is an AF the extensions of which are *exactly* those in E. Implicitly, this definition hence requires that *all* other sets of arguments must *not* be extensions of the AF of interest. This strictness requires that we have *complete* knowledge of the extensions of interest, and further, in order to actually construct a corresponding AF of interest, relies on the assumption that the set of extensions are *not conflicting* in terms of allowing them to be exactly represented by an AF. However, from more practical perspectives, we foresee these requirements to be somewhat cumbersome. Firstly, the requirement of complete knowledge implies in the worst case taking into account an exponential number of extensions. Secondly, the definition does not allow for "mistakes" or noise in the process of obtaining the extensions, and also rules out the possibility of dealing with multiple sources of potentially conflicting sets of extensions.

In this work we propose and study what we call the *AF synthesis problem*. Specifically, AF synthesis relaxes the notion of realizability to incomplete information—assuming only partial knowledge of extensions and non-extensions as *positive* and *negative examples*—and noisy settings, by allowing for expressing relative trust in the examples via weights. In this generalized setting, we define AF synthesis as the constrained optimization task of finding an AF that optimally represents the given examples in terms of minimizing the costs (defined via the weights of the given examples) incurred from the AF by including a negative example or not including a positive example.

The contributions of the work include the following. The relationship of AF synthesis and realizability is analyzed in terms of necessary and sufficient conditions for an AF synthesis instance to be realizable under different AF semantics. In addition, complexity results for AF synthesis for the conflict-free, admissible, and stable semantics are provided, with the main result that AF synthesis is in the general case NP-complete under each of these semantics. Finally, a constraint-based approach to optimal AF synthesis is developed, by providing declarative encodings for AF synthesis in the Boolean optimization paradigm of maximum satisfiability (MaxSAT), and the approach is empirically evaluated based on benchmarks from the recent ICCMA'15 argumentation solver competition [7] as well as additional randomly generated AF synthesis instances.

For the experiments, we used the state-of-the-art MaxSAT solver MSCG [8]. For the ICCMA instances under the stable semantics, almost every instance can be solved within the timeout limit of 900 seconds for up to 100 examples. On the random instances the number of negative examples under the admissible semantics clearly correlates with runtimes, but under the stable semantics it does not appear to have a noticeable effect on the runtimes. This is inline with our complexity analysis, as under the stable semantics AF synthesis remains NP-complete even without any negative examples, unlike under admissible.

We proposed AF synthesis as a generalization of the important problem of realizability in abstract argumentation. For future work, we hope to establish the computational complexity of AF synthesis under further central AF semantics, and thereafter extend the MaxSAT-based approach to cover additional semantics.

References

[1] Andreas Niskanen, Johannes P. Wallner, and Matti Järvisalo. Synthesizing argumentation frameworks from examples. In *Proc. ECAI*. IOS Press, 2016.

[2] T.J.M. Bench-Capon and Paul E. Dunne. Argumentation in artificial intelligence. *Artificial Intelligence*, 171(10-15):619–641, 2007.

[3] Phan Minh Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, 77(2):321–358, 1995.

[4] Paul E. Dunne, Wolfgang Dvořák, Thomas Linsbichler, and Stefan Woltran. Characteristics of multiple viewpoints in abstract argumentation. *Artificial Intelligence*, 228:153–178, 2015.

[5] Martin Diller, Adrian Haret, Thomas Linsbichler, Stefan Rümmele, and Stefan Woltran. An extension-based approach to belief revision in abstract argumentation. In Qiang Yang and Michael Wooldridge, editors, *Proc. IJCAI*, pages 2926–2932. AAAI Press, 2015.

[6] Jérôme Delobelle, Adrian Haret, Sébastien Konieczny, Jean-Guy Mailly, Julien Rossit, and Stefan Woltran. Merging of abstract argumentation frameworks. In *Proc. KR*, pages 33–42. AAAI Press, 2016.

[7] Matthias Thimm, Serena Villata, Federico Cerutti, Nir Oren, Hannes Strass, and Mauro Vallati. Summary report of the first international competition on computational models of argumentation. *AI Magazine*, 37(1):102–104, 2016.

[8] Antonio Morgado, Alexey Ignatiev, and Joao Marques-Silva. MSCG: Robust core-guided MaxSAT solving. *Journal on Satisfiability, Boolean Modeling and Computation*, 9:129–134, 2015.

Abstract Argumentation for Argument-based Machine Learning

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Abstract. The aim of this research in the field of argumentation is twofold: firstly, to study an abstract framework with complex kinds of interactions and additional information that may be applied to represent real world hot topics, such as social-web discussions; secondly, to exploit argument-based reasoning in Multistrategy Learning strategies of ILP systems, aiming at create first order theories able to explain learning examples in terms of arguments that justify them.

Keywords. Abstract Argumentation, Argument-based Machine Learning, Inductive Logic Programming, Multistrategy Learning

Abstract Argumentation [3] represents knowledge in terms of arguments along with an attack relation between them by using a general schema called Argumentation Framework (AF). Different semantics exist, all determined on the basis of the conflicts between arguments, yielding sets of accepted arguments called extensions. Recent studies have shown that other kinds of interaction may exist between the arguments. For instance, arguments can attack other arguments, but they can also support other ones [1]. In another extension of the standard AF [4] attacks between arguments are associated with a numeric weight, indicating the relative strength of the attack. Considering weighted AF, the literature lacks of further studies accounting for the intrinsic strength of arguments, by associating them with weights connoting their degree of reliability in a dispute. A preliminary work in this direction can be found in [9], that proposed a strategy to evaluate AFs with embedded weigths on nodes as authority degrees. Abstract Dialectical Frameworks (ADFs) [2] are a generalization of the classical AF allowing for many interaction between arguments but still does not embrace the idea of considering intrinsic strength of arguments. Therefore, a first proposal of this work is to define a general framework which takes into account all kinds of interaction between arguments, from attacks to support relations, combining both the intrinsic strength of arguments and the strength of relations between them, and understand how this information spreads in the resulting model. Moreover, one might focus the study on the definition of a secondary graph representing the proponents (and opponents) who state arguments weighted by their authority degree. Therefore, the elicited interest in this sense is how such a graph affects the AF. The purpose of this study might be applied in real world hot topics, such as analysis of forum threads and discussions in social networks.

The idea of Argument-based Machine Learning (ABML) [8], a combination of Machine Learning (ML) and Argumentation, is to induce a hypothesis that is consistent with learning data and provided arguments. Recently, in [7], some open issues and challenges have been drawn up to improve the synergy between ML and Argumentation. Argument-based reasoning may be better exploited in ABML in order to extract group(s) of arguments (i.e., extensions) by using an AF instead of just single arguments. Moreover, argumentation may help ML methods to discover rules that would infer correct classes for all learning examples. As a possible direction, Inductive Logic Programming (ILP) can be interfaced with argumentation reasoning. ILP approaches can take advantages from the adoption of a framework that integrates multiple inference strategies [6]. The exploitation of combined operators and their cooperation give a significant contribution to the improvement of the effectiveness and efficiency of the learning process and to the reduction in complexity of the learning problem [5]. Therefore, the second aim of this work is to consider argumentation reasoning as a further inferential operator to be combined in a multistrategic setting. Hence, argumentation could make up for some deficiencies for the justification of observations in the learning and revision process of first order theories. The use of argumentation in this perspective can be detected in the following proposals:

- Given a set of atoms from different observations with inconsistent information, argumentation can help to select the most prominent subset of observations (i.e., an extension) that remain consistent, so as to discard this information that is not relevant to the achievement of the learning goal.
- Requiring that some arguments give exactly the justified reasons to support a learning example, argumentation reasoning can help to infer those elements in which the given arguments are justified.
- By specifying reasons in favour (resp. against) the concept to be learned from positive (resp. negative) arguments, as in [8], the aim is to guide learning of first order theories to be consistent with the argumented examples.

Acknowledgments

I would thank my supervisor Prof. Stefano Ferilli and Prof. Floriana Esposito for the help in achieving the fixed objectives for the doctoral thesis. This work was partially funded by the Italian PON 2007-2013 project PON02_00563_3489339 ‘Puglia@Service’.

References

[1] L. Amgoud et al. On the bipolarity in argumentation frameworks. In *NMR*, pages 1–9, 2004.

[2] G. Brewka and S. Woltran. Abstract dialectical frameworks. In *Principles of Knowledge Representation and Reasoning: Proceedings of the Twelfth International Conference, KR 2010*. Citeseer, 2010.

[3] P. M. Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artificial intelligence*, 77(2):321–357, 1995.

[4] P. E. Dunne, A. Hunter, P. McBurney, S. Parsons, and M. Wooldridge. Weighted argument systems: Basic definitions, algorithms, and complexity results. *Artificial Intelligence*, 175(2):457 – 486, 2011.

[5] F. Esposito, N. Fanizzi, S. Ferilli, T. Basile, and N. Di Mauro. Multistrategy operators for relational learning and their cooperation. *Fundamenta Informaticae*, 69(4):389–409, 2006.

[6] R. S. Michalski. Inferential theory of learning. developing foundations for multistrategy learning. In R. S. Michalski and G. Tecuci, editors, *Machine Learning. A Multistrategy Approach*, volume IV, pages 3–61. Morgan Kaufmann, 1994.

[7] S. Modgil et al. The added value of argumentation. In *Agreement Technologies*, pages 357–403. Springer, 2013.

[8] M. Možina, J. Žabkar, and I. Bratko. Argument based machine learning. *Artificial Intelligence*, 171(10):922–937, 2007.

[9] A. Pazienza, F. Esposito, and S. Ferilli. An authority degree-based evaluation strategy for abstract argumentation frameworks. In *Proceedings of the 30th Italian Conference on Computational Logic*, pages 181–196, 2015.

Automatic Extraction and Structure of Arguments in Legal Documents

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1. Introduction

Arguments are one of the most fundamental tools for human beings to discuss their ideas and explain their points of view. During a discussion's period, one's logic, evidence, facts and figures are used in supporting or attacking the arguments presented by an opponent. At a time when social media has become a major discussion platform fueled by the most recent technologies, the number of participants/contributors expressing their opinion has increased exponentially. It is thus possible to gather plenty of arguments which are being used to generate these ideas. One of the most effective domain of the argument is in the Judicial System. Before advocating, lawyers and other stakeholders of the court, need to be aware of the type of the arguments used in previous cases. This can help to form an effective, efficient and uniform judgment in the case. Motivated by such need, the main purpose of this study is to identify and evaluate the structure arguments present in legal documents. Our corpus is made up of 42 case-laws from the European Court of Human Rights (ECHR) annotated by Mochales and Moens [1], are selected.

To accomplish the task, we propose to develop a system that automatically identifies arguments, their internal structure (premises and conclusion), as well as existent relations with other arguments. The system consists of four (4) modules as follows:

1. "Argument vs. Non-Argument (A-NA) Module". It deals with identifying argumentative and non-argumentative sentences in narrative legal texts;
2. "Argument Structuring (AS) Module". It handles the structuring of arguments;
3. "Premise - Conclusion (PC) Module". It distinguishes components (premise and conclusion) of the arguments;
4. "Relation (R) Module". It finds the relations between arguments and within the argument.

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2. Current Work

In the first module, we purpose a system to identify the argumentative sentences from unstructured text automatically. To accomplish this task, three kinds of experiments are conducted: Preliminary, Multi Feature and Tree Kernel. Each of them are described briefly :

Preliminary Experiment : In preliminary experiment, we used an unigram (bag of words) approach to represent the document with TF-IDF function normalized the unit length. The features are extracted and performance is measured of Random Forest Algorithm and Support Vector Machine (SVM) with a 10 folds cross - validation procedure. The performance of the algorithm is measured on the top informative features which are selected through gain ratio measure.

Multi Feature Experiment : Multi Feature Experiment is categorized according to the type of features available in the corpus. Bag of words approach is used to represent the document with TF-IDF function normalized the unit length. The experiment is divided into three categories: collective based approach, categorized based approach, merge based approach. Furthermore, categorized based approach is divided into three: ”Word n-gram”, ”POS ngram”, and ”Doc Info”. The performance of the Support Vector Machine (SVM) with a 10 folds cross - validation procedure is also measured on the top informative features which are selected through gain ratio measure.

Tree Kernel Experiment : Tree Kernel, experiment is conducted in the SVM-Light software written by Thorsten Joachims[1]. We generated the flatten parser tree and TF-IDF value to allocate each sentence to create a combination of models in between Tree Kernel function [2] and feature vectors. Three kinds of features were proposed, first : Syntactic Parser second: Syntactic Parser with 2000 top informative TF-IDF features; third: 2000 top informative TF-IDF.

Result : After accumulating all the data and selecting the best feature, the results obtained are nearly inline with our expectation. ”Collective Based Approach” of multi feature approach is considered the best approach as it scored 0.705 f-measure value from 20000 features. The result obtained is quite promising and supports our proposal for the creation of a new argument mining framework.

3. Acknowledgment

I would like express my sincere gratitude to my supervisors, Professor Paulo Quaresma and Professor Teresa Gonçalves for their encouragement and support. Thanks to Cristina Aǵua-Mel for her advice on academic writing.

References

[1] R. M. Palau and M. Moens, “Study on sentence relations in the automatic detection of argumentation in legal cases,” *FRONTIERS IN ARTIFICIAL INTELLIGENCE AND APPLICATIONS*, 165:89, 2007.

[2] A. Moschitti, “A study on convolution kernels for shallow semantic parsing,” In *Proceedings of the 42nd Annual Meeting on Association for Computational Linguistics*, page 335. Association for Computational Linguistics. July, 2004

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Enhancing Decision-Making and Knowledge Representation with Argumentation Theory

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Argumentation theory (AT) is a paradigm that investigates how arguments can be represented, supported or discarded in a reasoning process and at the same time examines the validity of the conclusion reached. Emerged in the last years, it is a computational approach aimed at modelling defeasible and non-monotonic reasoning this being close to the ways humans reason under uncertainty [1]. AT has demonstrated appealing characteristics in different research areas, including decision-making and knowledge representation. A decision-making problem is equivalent to the selection of a course of action or belief among several possible alternatives, these sometimes being in contrast to each other. Examples include the decision-making under uncertainty that often occur in health-care and medicine, where medical diagnosis, treatment efficacy or outcomes need to be evaluated [2,3]. Information accounted for in such reasoning processes is often heterogeneous, incomplete and complex. Additionally, the different pieces of information taken into account might be in contradiction to each other thus a method for resolving emerging inconsistencies is often necessary. Besides decision-making, AT can be applied to knowledge representation problems [4] as in the case of the constructs of mental workload (MWL) and trust. Specifically, in the case of MWL there is no clear and widely accepted definition thus representing MWL is not a trivial problem. A basic definition of MWL can be set as the amount of necessary effort devoted to a certain task within a period of time. In reality, due to its multi-faceted nature, the knowledge necessary for modelling MWL is vast, uncertain and contradictory. For these reasons, modelling MWL has been proposed as a form of defeasible reasoning [5,6]. In the case of trust, the scenario is very similar. Here a trustor has usually a knowledge-base of arguments, often contradicting, that needs to be aggregated and evaluated for enabling the interaction with a trustee entity. This evaluation can be seen as a defeasible reasoning activity made up of assertions, seen as presumptions which are not deductively valid but whose validity can be attacked or supported by new evidence [7].

Despite promising results have been found in several areas [8], demonstrating argumentation theory as a solid theoretical research discipline for implementing defeasible reasoning in practice, there are issues for applied research. State-of-the-art models of AT are usually ad-hoc, not often built upon all the layers of an argumentation process (figure 1). Due to this diversity characterising existing models, a clear structure that can be replicated and that can allow models to be compared has not emerged yet [9]. In this research we propose to tackle these issues and we define a list of objectives as it follows:

1. To design a complete defeasible argument-based framework that includes the layers suggested in the literature, as per figure 1;
2. To implement such a framework employing modern web-based technologies to facilitate its use across different fields by different practitioners;
3. To adopt the framework for decision-making and knowledge representation with applications in health-care, mental workload and trust modelling;
4. To evaluate the inferences generated by the framework and compare them against the ones produced by some of the existing approaches for handling uncertainty.

The hypothesis is that the inferences produced by this framework can enhance decision-making and knowledge representation as compared to a selection of state-of-the-art techniques for representing, reasoning over and handling uncertainty. These might include fuzzy non-monotonic reasoning, expert systems or Bayesian inference.

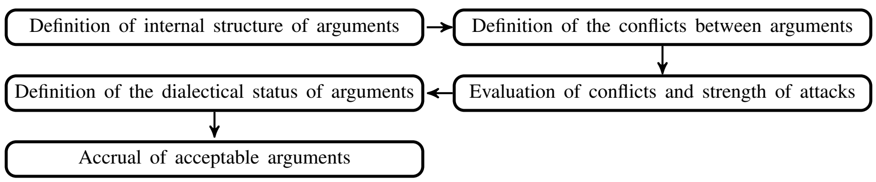

Figure 1. Steps for the construction of a multi-layer argument-based framework

Keywords. Argumentation theory, Decision-making, Knowledge Representation.

Acknowledgments. Lucas Middeldorf Rizzo would like to thank CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for his Science Without Borders scholarship, proc n. 232822/2014-0 and Dr. Luca Longo for his assistance and feedback.

References

[1] P. M. Dung, P. Mancarella, and F. Toni, "Computing ideal sceptical argumentation," *Artificial Intelligence*, vol. 171, no. 10, pp. 642–674, 2007.

[2] D. Glasspool, J. Fox, A. Oettinger, and J. Smith-Spark, "Argumentation in decision support for medical care planning for patients and clinicians," in *AAAI Spring Symposium: Argumentation for Consumers of Healthcare*, pp. 58–63, 2006.

[3] R. Craven, F. Toni, C. Cadar, A. Hadad, and M. Williams, "Efficient argumentation for medical decision-making," in *KR*, 2012.

[4] J. Bentahar, B. Moulin, and M. Bélanger, "A taxonomy of argumentation models used for knowledge representation," *Artificial Intelligence Review*, vol. 33, no. 3, pp. 211–259, 2010.

[5] L. Longo, *Formalising Human Mental Workload as a Defeasible Computational Concept*. PhD thesis, Trinity College Dublin, 2014.

[6] L. Longo, "A defeasible reasoning framework for human mental workload representation and assessment," *Behaviour and Information Technology*, vol. 34, no. 8, pp. 758–786, 2015.

[7] S. Parsons, P. McBurney, and E. Sklar, "Reasoning about trust using argumentation: A position paper," in *International Workshop on Argumentation in Multi-Agent Systems*, pp. 159–170, Springer, 2010.

[8] T. J. Bench-Capon and P. E. Dunne, "Argumentation in artificial intelligence," *Artificial intelligence*, vol. 171, no. 10, pp. 619–641, 2007.

[9] L. Longo and P. Dondio, "Defeasible reasoning and argument-based medical systems: an informal overview," in *27th International Symposium on Computer-Based Medical Systems, New York, USA*, pp. 376–381, IEEE, 2014.

Properties and Computational Complexity of Different Models for Abstract Argumentation

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Abstract. While the standard argumentation formalisms can be successfully used to model many argumentation scenarios and discussions, they are often not capable of capturing the mixture of problems we encounter during many real world argumentation processes. In my PhD thesis, I work on identifying these problems and investigate them more closely. So far, the main problems we encountered are a high grade of dynamics, incomplete information, and highly complex user opinions.

Keywords. abstract argumentation, non-monotonic reasoning, computational complexity

Introduction

On the one hand, abstract argumentation, as it was introduced by Dung [5], can be used as a tool to model a lot of the real real world argumentation scenarios we encounter. On the other hand, it turned out in the past that there is a need for various adaptions of Dungs model to fit better to specific situations. This includes partial argumentation frameworks, preference-based argumentation, probabilistic argumentation frameworks, value-based argumentation frameworks, extended argumentation frameworks, and abstract dialectical frameworks. However, these extensions cannot deal adequate with the three main problems we encountered during the first phase of our studies of real world applications in the frame of the graduate school of our university[2].

First, we often have to deal with highly dynamic online situations, where users may join or leave discussions arbitrarily, but also change their opinion. Second, we cannot count anymore on complete information, as it is not feasible to ask for a users opinion on every aspect of the discussion, or even assume that a user is aware of all known information. Third, we have to find a way to account for the most complex opinions a user can give, which includes, but is not restricted to, opinions that weaken the very structure of earlier expressed opinions of other users.

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The former two problems have been recently discussed by Baumeister et al. [2], who worked mainly on incompleteness regarding the attack relation of argumentation frameworks, while we tackled this problem in regard to incompleteness of the argument set [3]. The latter problem has been studied by Baroni et al. [1], who analyzed the behavior of argumentation frameworks in which it is allowed that attacks target attacks, instead of only arguments. The recent work by Strass [7] investigates how defeasible theories can be instantiated as abstract dialectical frameworks. This last approach allows for a much wider range of user opinions to be expressed satisfactorily.

Our work is directly connected to the practical applications of the graduate school at our university, mainly the dialog-based argumentation system by Krauthoff et al. [6]. A *web of reasons*, which is the direct translation of the underlying database scheme of their work, consists of a set of *statements*, i.e., the atoms of the discussion, and a set of *inference rules*. An inference rule consists of its premises, i.e., a subset of the statements or their negations, and its conclusion, which is either a statement or its negation, or another inference rule or its negation.

Uniting the ideas of Baroni et al. [1] and Strass [7] we can now instantiate our model as a *defeasible theory w.r.t. a web of reasons*, which yields a defeasible theory without any strict rules, but with defeasible rules that can have another rule as their conclusion. Strass offers in his work [7] a way to translate such defeasible theories into abstract dialectical frameworks, a powerful extension of argumentation frameworks due to Brewka and Woltran [4].

Our next milestone is to characterize sets of credulously, reps. skeptically, acceptable statements of the above model, and analyze corresponding decision problems in regard to their computational complexity.

References

[1] P. Baroni, F. Cerutti, M. Giacomin, and G. Guida. Afra: Argumentation framework with recursive attacks. *International Journal of Approximate Reasoning*, 52(1):19–37, 2011.

[2] D. Baumeister, D. Neugebauer, and J. Rothe. Verification in attack-incomplete argumentation frameworks. In *Proceedings of the 4th International Conference on Algorithmic Decision Theory*, pages 341–358. Springer-Verlag *Lecture Notes in Artificial Intelligence*, September 2015.

[3] D. Baumeister, J. Rothe, and H. Schadrack. Verification in argument-incomplete argumentation frameworks. In *Proceedings of the 4th International Conference on Algorithmic Decision Theory*, pages 359–376. Springer-Verlag *Lecture Notes in Artificial Intelligence*, September 2015.

[4] G. Brewka and S. Woltran. Abstract dialectical frameworks. In *Principles of Knowledge Representation and Reasoning: Proceedings of the Twelfth International Conference, KR 2010*. AAAI Press, 2010.

[5] P. Dung. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, 77(2):321–357, 1995.

[6] T. Krauthoff, M. Baurmann, G. Betz, and M. Mauve. Dialog-based online argumentation. In *Computational Models of Argument: Proceedings of COMMA 2016*. IOS Press, 2016.

[7] H. Strass. Instantiating knowledge bases in abstract dialectical frameworks. In *Computational Logic in Multi-Agent Systems*, pages 86–101. Springer, 2013.

Relations between Syntax and Semantics in Abstract Argumentation [1]

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Keywords. argumentation, semantics, existence, conflict, equivalence

In the past three years I have been working on various aspects of abstract argumentation [1]. In a way these aspects can be summarized as relations between syntax and semantics. As syntax I understand structural properties of argumentation graphs, i.e., the most obvious intersection between graph theory and abstract argumentation. As semantics I understand acceptance conditions given some argumentation framework but also existence of frameworks given some extension set. In the following I will first (Definition 1) briefly discuss relevant concepts of abstract argumentation and then (Section 1) elaborate on what I mean by relations between syntax and semantics. My poster features neat illustrations of interesting examples and conjectures also regarding future research directions. As of right now my work is a discussion of syntactic and semantic existence conditions of extensions for various semantics, and an investigation of the relations between syntactic and semantic conflicts as well as applications of related observations.

Definition 1. An *Argumentation Framework* (AF) is a pair $F = (A,R)$ where A is a set of arguments and $R \subseteq A \times A$ is called the attack relation. Given some AF $F = (B,S)$ we use $A_F = B$ and $R_F = S$ to denote its arguments and attacks respectively. Given some AF F and a set $S \subseteq A_F$ we use $S^+_F = \{a \in A_F \mid \exists b \in S, (b,a) \in R_F\}$ to denote its outward range. As syntax of abstract argumentation we henceforth understand AFs, arguments, attacks, and structural properties derived thereof; e.g. finitariness (each argument has at most finitely many attackers), loops ($(a,a) \in R_F$), cycles (directed paths $(a_i)_{0 \leq i \leq n}$ with $a_0 = a_n$) and planarity (drawable without crossing attacks) are syntactic properties.

A *semantics* informally is a collection of acceptance conditions and formally is a mapping σ such that for any given AF F we have $\sigma(F) \subseteq \wp(A_F)$, we call $S \in \sigma(F)$ a σ-extension and $\sigma(F)$ an extension set. For instance *stable* semantics is defined as extensions $S \subseteq A_F$ with *conflict-freeness* ($S \cap S^+_F = \emptyset$) and *totality* ($S \cup S^+_F = A_F$). The other way around a set $\mathbb{S}$ of sets of arguments is called *σ-realizable* if there is some AF F such that $\sigma(F) = \mathbb{S}$. For instance any set of maximal conflict-free sets (for each pair of sets there is a pair of arguments that never occur together) is stable-realizable [2]. *Stage* extensions are range-maximal ($S \cup S^+_F$) conflict-free sets S. *Cf2* semantics also builds on maximal conflict-free sets but considers arguments that occur earlier in all directed argument chains as more important.

[1] This research has been supported by the Austrian Science Fund (FWF) through projects I1102 and I2854.

1. Relations between Syntax and Semantics

As *collapse* (see [3]) of some semantics σ for a given AF F we understand the case of $\sigma(F) = \emptyset$. When investigating argumentation structures inevitably syntactic properties attract attention. It is fairly well known that stable semantics might collapse. My short paper at COMMA this year (Perfection in Abstract Argumentation) includes an example with collapse of stable, stage and semi-stable semantics for a cycle- and loop-free AF, and also a conjecture that stage semantics does not collapse for planar AFs.

For some scenarios we do not want collapsing AFs. Hence it is of interest to classify AFs F for which no induced sub-AF G ($A_G \subseteq A_F$ and $R_G = (A_G \times A_G) \cap R_F$) collapses for semantics σ, a.k.a. *Perfection*. For stage semantics there is a nice characterizing theorem for perfect AFs, i.e. if the induced sub-AF G is stage-perfect, then a collapsing F consists of infinitely many more arguments than G. Future research directions in this area include additional semantics and further AF properties. For instance cf2 semantics was conjectured to not collapse for finitary AFs in [4].

Notions of *Expressiveness* (e.g. [5]) relate semantics in regards to extension sets they are able to realize. In [6] we investigate 2-dimensional *signatures*, i.e. characterizations of pairs of extension sets such that for a given pair of semantics there is a single AF realizing both extension sets respectively. An apparent open question to be dealt with in future work are the gaps left open: on the one hand further semantics (such as stage and cf2), on the other the exact relation between preferred and semi-stable semantics. It can be pointed out that conflict is a substantial ingredient to solving the latter.

Conflict can easily be seen as a syntactic notion, two arguments are in *syntactic conflict* if none is attacking the other. Conflict however also has an implicit, semantic interpretation, two arguments are in *semantic conflict* if they never appear together in any extension. Pending work on the matter investigates to what extent syntactic conflicts can be added to or removed from some AF without changing the given extension sets for some semantics. In particular for stage (and trivially for cf2) semantics it appears that conflicts can be necessary, but attacks can not. Future work on conflict consists of publishing gathered results and working out more shades of conflict, e.g. in [7] we set out for conflicts under the condition that modifications may not add additional arguments.

References

[1] Phan Minh Dung. On the Acceptability of Arguments and its Fundamental Role in Nonmonotonic Reasoning, Logic Programming and n-Person Games. *Artif. Intell.*, 77(2):321–358, 1995.

[2] Paul E. Dunne, Wolfgang Dvorák, Thomas Linsbichler, and Stefan Woltran. Characteristics of multiple viewpoints in abstract argumentation. *Artif. Intell.*, 228:153–178, 2015.

[3] Christof Spanring. Hunt for the Collapse of Semantics in Infinite Abstract Argumentation Frameworks. In *ICCSW*, volume 49 of *OASICS*, pages 70–77, 2015.

[4] Ringo Baumann and Christof Spanring. Infinite Argumentation Frameworks - On the Existence and Uniqueness of Extensions. In *Advances in Knowledge Representation, Logic Programming, and Abstract Argumentation*, volume 9060 of *Lecture Notes in Computer Science*, pages 281–295, 2015.

[5] Wolfgang Dvořák and Christof Spanring. Comparing the expressiveness of argumentation semantics. *Journal of Logic and Computation*, 2016.

[6] Paul E. Dunne, Thomas Linsbichler, Christof Spanring, and Stefan Woltran. Investigating the relationship between argumentation semantics via signatures. In *Proc. IJCAI*, pages 1051–1057, 2016.

[7] Thomas Linsbichler, Christof Spanring, and Stefan Woltran. The Hidden Power of Abstract Argumentation Semantics. *TAFA*, 2015.