AMANDE - Argument Strength

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April 10-12, 2018, Toulouse, France

Book of abstracts

Abstracts of the Workshop "AMANDE - Argument Strength 2018"

April 10-12, 2018, Toulouse, France

AMANDE - Argument Strength 2018

After the successful edition of the Workshop on Argument strength which was held in Bochum in 2016, a second edition is organised in April 2018 in Toulouse. The strength of an argument depends on many parameters (e.g. the plausibility of its premises, the nature of the link between the premises and the conclusion, or the relations between this argument and the other ones). This workshop aims at gathering experts on argumentation from different fields (artificial intelligence, logic, philosophy,...) to discuss the questions related to the strength of arguments. Such questions include (but are not limited to)

- Which factors influence the strength of an argument?
- What are the pros and cons of different formal representations of argument strength?
- How to formally model qualifiers on the conclusions of arguments?
- How does argument strength propagate when inferences are chained?
- How do arguments accrue?
- Can weaker arguments defeat and/or defend stronger arguments?
- When do more specific arguments defeat more general arguments and vice versa?
- How do formal and informal approaches to argument strength relate?
- How do preferences assigned to premises influence the evaluation of arguments?

This edition of Argument Strength will be joint with a one-day workshop linked to the research themes of the French project AMANDE, that include alternative semantics for argumentation (in particular ranking semantics), dynamics of argumentation frameworks, decentralised protocols for argumentation and strategical aspects of argumentation and deliberation.

Program

April 10th will be devoted to the AMANDE day; April 11th and 12th will be devoted to Argument Strength workshop. Confirmed keynote speakers:

- For AMANDE Day
  - Nicolas Maudet (Université Pierre et Marie Curie, Paris)
  - Stefan Woltran (Technische Universität Wien)
- For Argument Strength
  - Leila Amgoud (CNRS)
  - Pietro Baroni (Università degli Studi di Brescia)
  - Anthony Hunter (University College London)
  - Francesca Toni (Imperial College London)

Organizing committee

Leila Amgoud
Sylvie Doutre
Patricia Everaere
Jean-Guy Mailly
Stefano Moretti
Gabriella Pigozzi
Srdjan Vesic

Scientific program

April 10th, AMANDE day, 8.30-17.35

9.00-10.00, Invited talk by Stefan Woltran

Expressibility of Argumentation Frameworks and its Relation to the Dynamics of Argumentation

Stefan Woltran[1]

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In this talk, we first review results about the expressibility of argumentation frameworks. These results tell us which sets of extensions can be expressed by argumentation frameworks under the different semantics. We discuss how these results affect the tasks of revision and enforcement when defined on a semantical level. We then switch from an argument-centric view to a claim-centric view which is more appropriate when argumentation frameworks are understood as the result of an instantiation process. We present some novel results on expressibility in this setting and sketch future avenues for research on the dynamics of argumentation under this claim-centric view.

Strategic Manipulation when Merging Argumentation Frameworks

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Our work looks at strategic aspects of merging argumentation frameworks (AFs). Merging refers here to the consolidation, via semantic aggregation, of potentially diverging arguments (or viewpoints) in a profile of AFs coming from different agents. Strategic manipulation is possible when an agent can change the outcome in her favor by not reporting her AF truthfully. We take the goal for manipulation to be the acceptance of arguments, e.g., ensuring skeptical acceptance of an argument. The framework of merging propositional knowledge bases under integrity constraints serves as a general foundation from which we derive results for the case of merging AFs. Integrity constraints appear useful in the case of merging AFs: they can be used to allow only extensions present in at least one input AF, or can encode logical inconsistencies between certain arguments. Our aim is to apply earlier insights of Everaere et al. (2007) and (a) identify conditions under which strategic manipulation is possible in the propositional case, (b) understand the ways in which adding a new AF to an existing profile can alter the final output, such as to (c) study manipulation under merging of AFs.

Prioritized norms in formal argumentation: from totally ordered to preordered

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In our previous work, using hierarchical abstract normative systems, we defined three kinds of prioritized normative reasoning approaches, called Greedy, Reduction, and Optimization, and showed that for a totally ordered hierarchical abstract normative system, Greedy and Reduction can be represented in argumentation by applying the weakest link and the last link principles respectively, and Optimization can be represented by introducing additional defeats capturing the idea that for each argument that contains a norm not belonging to the maximal obeyable set then this argument should be rejected. However, for a preordered hierarchical abstract normative system, how to represent it in argumentation is an open problem. For instance, consider a normative system with a set of four abstract norms $\{(a,b),(b,\bar{c}),(a,c),(c,\bar{b})\}$, and the priorities assigned to these norms are respectively 1, 2, 1 and 2. Assume that a is the context. Then, in Greedy, there are two extensions $\{b,\bar{c}\}$ and $\{c,\bar{b}\}$, while under stable semantics, the corresponding argumentation framework by using the weakest link has three argument extensions $\{ab, ab\bar{c}\}$, $\{ac, ac\bar{b}\}$ and $\{ab, ac\}$,resulting three conclusion extensions $\{b,\bar{c}\},\{c,\bar{b}\}$ and $\{b,c\}$, where $\{b,c\}$ is not a Greedy extension. The reason behind this mismatching is that when we define the priority over arguments, we have not considered how the accepting of an argument might affect the priority of its superargument. For instance, in the above example, when ab is considered to be accepted, the priority of $ab\bar{c}$ will change from $(1,2)$ to (2). Based on this observation, in this paper, we introduce a new approach for representing a preordered hierarchical abstract normative system in formal argumentation.

Arguing About Constitutive and Regulative Norms

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Formal arguments are often represented by (support, conclusion) pairs, but in this paper we consider normative arguments represented by (brute, institutional, deontic) triples, where constitutive norms derive institutional facts from brute facts, and regulative norms derive deontic facts like obligations and permissions from institutional facts. The institutional facts may be seen as the reasons explaining or warranting the deontic obligations and permissions, and therefore they can be attacked by other normative arguments too. We represent different aspects of normative reasoning by different kinds of consistency checks among these triples, and we use formal argumentation theory to resolve conflicts among such normative arguments. In particular, we introduce various requirements for arguing about norms concerning violations, contrary-to-duty obligations, dilemmas, conflict resolution, and different kinds of norms, and we introduce a formal argumentation theory satisfying the requirements.

Inferring Implicit Abstract Argument Preferences

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Abstract

Preference-based argumentation framework provides a useful mechanism to tolerate or handle inconsistent information. However, there is a lack of an automated approach for inference and verification of preferences. We present some preliminary research to handle this issue by using conditional inference rules for inferring preferences. Our aim is to automatically infer preferences from an input argumentation graph and set of acceptable arguments and verify them to be correct.

Introduction

An abstract argumentation framework [5] is a directed graph consisting of nodes that represent unique atomic arguments and directed edges that represent the attack between two arguments. Consequently, acceptable sets of arguments called extensions for the argumentation graphs can be computed based on various acceptability semantics. Preference-based argumentation framework consists of preference relations over arguments [3, 1] that have different strengths e.g., when an argument relies on more certain or important information than another. Furthermore, preferences are taken into account in the evaluation of arguments at the semantic level, which is also known as preference-based acceptability [2, 4], where the basic idea is to accept undefeated arguments and also arguments that are preferred to their defeaters as these arguments defend themselves against their defeaters.

The question we seek to answer in our research is "How to infer and verify implicit argument preferences from an input abstract argumentation graph and an extension consisting of acceptable arguments based on preference-based acceptability semantics?". To answer this question, we are currently working on a novel algorithmic-approach to identify the arguments that survive from attacks, thereby inferring preferences for such arguments. We present two conditional preference rules in Section based on direct and indirect defence preferences between arguments.

Preference Types and Representations

Definition 1. *(Preference-based Argumentation Framework (PAF) [1]):*

A preference-based argumentation framework is a triple $(\mathcal{A}, \mathcal{R}, \mathcal{P})$ *where* $\mathcal{A}$ *is a set of arguments and* $\mathcal{R}$ *is a binary relation between arguments representing attacks among them* ($\mathcal{R} \subseteq \mathcal{A} \times \mathcal{A}$)*. The notation* $(A, B) \in \mathcal{R}$ *or* $A\mathcal{R}B$ *means that the argument* A *attacks the argument* B*.* $\mathcal{P}$ *is a partial pre-ordering (reflexive and transitive binary relation) on* $\mathcal{A} \times \mathcal{A}$*.*

A PAF introduces the notion of a defeat to represent an attack that is not successful based on argument preferences. We define two types (direct and indirect) of defence preferences as follows:

Definition 2. *(Direct Defence Preference): An argument* A *defends itself against an argument* B *which defeats* A *iff* A *is directly preferred to* B*. We define a direct defence preference* D *between arguments* A *and* B *as* $D = A >_A B$*, which means that argument* A *is directly preferred to argument* B *due to defence by* A *itself.*

Definition 3. *(Indirect Defence Preference): An argument* A *defends an argument* C *against an argument* B *which defeats* C *iff* C *is indirectly preferred to* B *because of defence by* A*. We define an indirect defence preference* I *between arguments* C *and* B *as* $I = C >_A B$*, which means that argument* C *is indirectly preferred to argument* B *due to defence by a third argument* A*.*

Conditional Rules for Inferring Preferences

By using Definitions 2 and 3 we define two conditional preference rules to infer direct and indirect defence preferences as follows, where $\mathcal{R}$ is the attack relation given in Definition 1, A, B, C are arguments in an abstract argumentation graph $\mathcal{A}$ and $\mathcal{E}$ is the set of acceptable arguments.

Definition 4. *(Direct Defence Preference Inference Rule)*
If

$$(A \in \mathcal{E}) \land (\exists B \in \mathcal{A} \; s.t. \; B\mathcal{R}A \; \land \; B \notin \mathcal{E}) \land (\nexists C \in \mathcal{E} \; s.t. \; C\mathcal{R}B)$$

then

$$D = A >_A B$$

In other words, if B attacks A and A is in the extension $\mathcal{E}$ and B is not in $\mathcal{E}$ and there does not exist any argument C that attacks B that is present in the extension $\mathcal{E}$ then we infer that it must be the case that $A >_A B$. This inference rule invalidates the attack $B\mathcal{R}A$ and we use the notation $B\mathcal{R}'A$ to denote such an unsuccessful attack.

Definition 5. *(Indirect Defence Preference Inference Rule):*
If

$$(B\mathcal{R}C) \land (A\mathcal{R}B) \land (A, C \in \mathcal{E}) \land (B \notin \mathcal{E})$$

then

$$I = C >_A B$$

In other words, if B attacks C and A attacks B and A, C are in the extension $\mathcal{E}$ and B is not in $\mathcal{E}$ then we infer that it must be the case that $C >_A B$ because of defence by A. This inference rule invalidates the attack $B\mathcal{R}C$.

Future Work

Our goal is to automate the computation and verification of preferences. In the future, we will also infer preferences from incomplete argumentation graphs with partial information about attacks, given an input extension of acceptable arguments. Furthermore, we will use different labellings (IN, OUT, UNDEC) that are given in the literature.

Acknowledgments

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Semantic Change in Abstract Argumentation

Jean-Guy Mailly[1], Sylvie Doutre[2]

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The semantics that applies to an abstract argumentation framework to determine the acceptability of arguments, may have to be changed. The reason for this change may be that the semantics is not appropriate any more, or because one wants to enforce the acceptability of some arguments. In order to perform the most suitable change, the current and a potential new semantics have to be compared. Difference measures between semantics are presented to this end. An application of semantic change to extension enforcement (ensuring that a given set of arguments becomes an acceptable set, or is included in an acceptable set) is also presented, in combination with potential changes on the framework. The use of semantic change is shown to minimize the changes of the framework when performing the enforcement. Other promising applications of semantic change are also outlined.

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14.00 - 15.00 Invited talk by Nicolas Maudet

Dynamics of Argumentative Debates

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In this talk I will discuss the properties and dynamics of some protocols for debate, when agents exchange arguments, possibly vote on arguments and/or attacks, and are supposed to follow simple strategies (typically, best responses). While in the setting of extension-based semantics it is possible, under some assumptions, to provide guarantees on the outcome of such debates, I will emphasize some challenges and open questions which arise if we move to a gradual notion of semantics.

Measuring the intensity of attacks in argumentation graphs with Shapley value

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In an argumentation setting, a semantics evaluates the overall acceptability of arguments. Consequently, it reveals the global loss incurred by each argument due to attacks. However, it does not say anything on the contribution of each attack to that loss. This paper introduces the novel concept of contribution measure for evaluating those contributions. It starts by defining a set of axioms that a reasonable measure would satisfy, then shows that the Shapley value is the unique measure that satisfies them. Finally, it investigates the properties of the latter under some existing semantics.

Increment and Threshold Approaches to Nonmonotonic Logic

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Xavier Parent (2011) distinguishes "two strategies of formalizing defeasible... reasoning". He calls the first the "increment" strategy, which consists in applying and restricting the application of nonmonotonic rules of inference in a step-by-step manner, incrementally adding to the set of rules one follows while avoiding contradictions. This approach is well-known and well-studied in the literature on nonmonotonic reasoning; a recent example is the default logic of John Horty (2012). Parent calls the second approach the "threshold" strategy, which consists in cutting the set of nonmonotonic rules down until it just barely passes the threshold of not yielding a contradiction. This approach is less well-known, and is embodied primarily by input/output logics; Parent and Leendert van der Torre (2013) provide an excellent overview of this framework.

Parent (2011) contrasts these two approaches, using Horty's system and a version of input/output logic as his examples of the strategies. He ultimately suggests that the threshold approach better captures our intuitions.

My purpose in this paper is two-fold. First, building on but significantly departing from Horty's system, I present a version of default logic that captures a sort of hypothetical reasoning, which Horty briefly discusses but does not pursue. This is reasoning we do when we evaluate decisions in part on the basis of the further decisions they force us to make. The system I define is of independent interest, as it captures in a natural and novel way the idea that, when we cannot follow all the rules we would like to follow, we ought to break the weakest or least important ones we can. It begins by identifying sets of triggered rules—rules to whose premises we are committed—we can consistently follow, and then compares them not on the basis of the rules they contain, but on the basis of the rules they violate—the triggered rules they do not contain.

Second, I show that this system of hypothetical reasoning in default logic is (effectively) equivalent to one of the systems Parent and van der Torre define. This tells us that for at least some purposes, there are no significant differences between the increment and threshold strategies. I leave open the question of whether every system from Parent and van der Torre is equivalent to some system that proceeds incrementally, though I suspect the answer is positive.

There is one further way of tying these two systems together. The idea mentioned above, of breaking the weakest rules we can, is not novel. It is similar to what Carlos Alchourrón (1985) asserts is "logical to believe":

> "It is logical to believe that the reasonable way of overcoming a conflict of obligations is to leave aside the less important norms contributing to its creation."

I do not discuss Alchourrón's method for capturing this idea with his notion of a "safe contraction," but Jörg Hansen (2006) provides a detailed comparison of his own approach to Alchourrón's, and Hansen's proposal produces results very similar to those of the systems I consider. This similarity is in fact not surprising, as Hansen (2008) employs a concept of violation similar to the one I define, and his notion of "preferred maximally obeyable subsets" is conceptually, though not quite extensionally, identical to the preffamily of input/output logic.

Unrestricted Rebuttal in Structured Argumentation

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Structured argumentation is a family of formal approaches for the handling of defeasible, potentially inconsistent information. In order to do so, many models for structured argumentation distinguish between strict and defeasible inference rules. Defeasible rules guarantee the truth of their conclusion only provisionally: from the antecedents of the rules we can infer their conclusion unless and until we encounter feasible counterarguments. Strict rules, in contrast, are outside doubt: the truth of the antecedents is carried over to the conclusion. In structured argumentation, the concept of argumentative attack is used to give a formal explication of the fact that two arguments express conflicting information. When constructing arguments with defeasible rules, it seems sensible that whenever an argument a concludes the contrary of a defeasible argument b, a should be allowed to attack b. The attack form known as rebuttal does exactly this. One can either allow for unrestricted rebuttal or restrict the reach of a rebuttal. In a framework allowing for unrestricted rebuttals, such as ASPIC^{-} [2], any defeasible argument can be rebutted. This contrasts sharply with more restricted notions of rebuttal to arguments only the last link of which is defeasible, as found e.g. in the ASPIC^{+}-framework [4]. In [2], it has been argued that, at least in a dialectical context, unrestricted rebut is more intuitive than restricted rebut. Recent empirical research [6] supports this claim.

Defeasible information often comes in varying degrees of strength. This feature of defeasible reasoning is represented formally by a preorder over the defeasible rules. Various lifting principles have been presented in the literature to determine the relative strength of an argument by looking at the strength of the defeasible rules used in the construction of the argument. The strength of arguments then comes into play when determining whether an attack (a purely syntactical relationship between arguments) results in a defeat. It is common to require that an argument a can only defeat an argument b if a is not weaker then b.

To facilitate the study of such structured argumentation systems, [1] proposed several postulates the output of any sensible argumentation system should satisfy. For example, it seems reasonable to require that the output of an argumentation system is consistent. Likewise, the output of an argumentation system should be closed under strict rules.

Strict rules can be based on some kind of deductive system, like classical logic. When using sufficiently strong deductive systems such as classical logic, however, one needs to be wary of problems that are caused by rules such as *ex falso quodlibet*: this may cause two syntactically disjoint argumentation systems to interact in undesirable ways. The absence of such problems has been labelled Crash Resistance in [5]. A violation of crash resistance can render an argumentation system ineffective since given conflicting defeasible rules, the conflict can spread to unrelated, innocent bystanders and thus contaminate the whole output. This seems to defeat the purpose of structured argumentation frameworks, since it is meant to give us a sensible output *especially* in the case of conflicting but defeasible information.

In this presentation we show that ASPIC^{-} , a system allowing for unrestricted rebuts, violates crash-resistance. We remedy this shortcoming by generalizing the attack rule of unrestricted rebut. Our resulting system ASPIC$^{\ominus}$ was shown in in [3] to satisfy all the usual rationality postulates for totally ordered prioritized rule bases while retaining the intuitiveness of unrestricted rebuttal. In the presentation, we will generalize this result for any preorder over the defeasible rules. Furthermore, we will show how the system can accommodate defeasible premises and the attack form of undercut (an attack on the application of a defeasible inference rule rather than on the conclusion of such a rule). Finally, we will present meta-theoretical properties of the consequence relations based on ASPIC$^{\ominus}$, such as Cautious Monotony.

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Contraposition in Structured Argumentation.

Christian Straßer[1]
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Suppose Peter is in class with Lisa and he told us that in two days is the exam. If there is an exam Lisa usually studies late in the library. Also, if she studies late in the library she usually takes the bus connection at 22:00 home (since later there are no busses). We're waiting for her at the station in anticipation of her arrival, but she doesn't step out of the bus when it arrives. Shall we still conclude that she studied late in the library? Shall we doubt Peter's statement about the exam in two weeks? Ultimately the question is: How cautious should we be when we reason defeasibly and reach a conflict? Shall the latter (in some cases) cast doubt on intermediate reasoning steps?

Out of the box, common structured argumentation frameworks (e.g., ASPIC and ABA) are in the greedy tradition of default logic: they apply defeasible modus ponens until a conflict is reached either with the given factual information or with other arguments. In some or many contexts this greedy behavior may be considered as promoting a style of reasoning that is too bold. Also, it means that properties such as Cautious Monotonicity do often not hold for structured argumentation frameworks.

Sometimes it is proposed to supplement the defeasible rule-set with contraposed rules. E.g., in the example above we would also have that if Lisa doesn't study late in the library there is usually no exam, and similar for the other rules. This leads to new defeating arguments and as a consequence some conclusions that could be reached before are now cancelled. However, contraposition for defeasible rules is controversial and by some considered too strong. Indeed, contraposition does not necessarily make our reasoning more cautious, adding contraposed rules can have the opposite effect. To see this, suppose Peter didn't tell us about the exam. With contraposed rules we can now defeasibly reason along the contraposed sequence of defeasible rules and safely infer that there is no exam and that Lisa didn't study late.

To accommodate this trade-off that comes with contraposed rules, some authors have proposed weak contraposition (e.g. [3]) which doesn't allow to defeasibly infer the negated antecedent from the negated conclusion of a rule, but rather something weaker. E.g., in the context of normative reasoning when dealing with conditional obligations and given a rule $A \Rightarrow B$ (if A you're obliged to B), from being obliged to $\neg B$ we derive to be allowed to $\neg A$ (or equivalently: not to be obliged to A) instead of being obliged to $\neg A$. In an epistemic context this means that the weak contraposition of $A \Rightarrow B$ does not give us a reason to believe $\neg A$ if we have a reason to believe $\neg B$, but rather it gives us a reason to not believe A (again, the negation is put outside of the modality, just like in case of deontic reasoning). This way (weak) contraposition is mainly responsible to produce defeaters and leads to a more cautious reasoning style.

Both strong and weak contraposition face a problem in cases as the following. Suppose our rules are $A \Rightarrow B \Rightarrow C$; $A' \Rightarrow B' \Rightarrow C'$; and $C \wedge C' \Rightarrow D$. Suppose further we have the information $\neg D$. Now suppose we want to reason with strong contraposition: then we infer $\neg(C \wedge C')$ from $\neg D$. However, how to continue from here? Ideally one would want to infer e.g. $\neg(B \wedge B')$ or $\neg B \vee \neg B'$. What is needed is a mechanism that allows one to reason by cases: since $\neg(C \wedge C')$ either $\neg C$ or $\neg C'$; in the first case $\neg B$ by weak contraposition, in the second case $\neg B'$ by weak contraposition, thus $\neg B \vee \neg B'$. Recently such a mechanism for structured argumentation has been proposed in [1].

In this talk we combine (weak and strong) contraposition for (prioritized) defeasible rules in structured argumentation with reasoning by cases. We study meta-theoretic properties such as the rationality postulates and properties of non-monotonic consequence relations (such as Cautious Monotonicity) for the resulting systems and compare them to Hang-Yourself-Arguments [2].

References

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Bipolar Leveled Frameworks (BLF) with weighted supports

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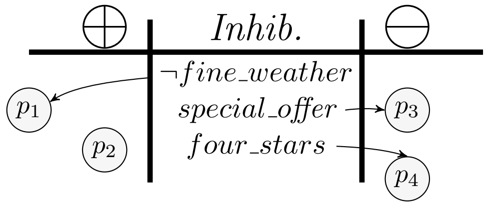
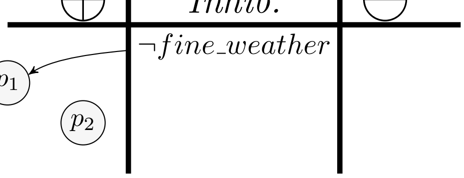
We start with two propositional languages: one which represents a set of attributes or features, some or all of which, may hold for a decision alternative; and the second represents a set of goals which are achieved when the alternative is chosen. A BLF has four components: (1) A set of *decision principles* (ϕ, ψ) which are intuitive assertion which says that a goal ψ (from the set of goals) is accomplished if the attribute ϕ (from the set of attributes) holds. (2) a set of *inhibitors* which can be thought of as observations that 'block' the defeasible rule contained in the decision principle; (3) a *polarity function* classifying goals as either desirable (positive) or undesirable (negative) and (4) a *total order on the set of goals* grading them from less important to more important. A decision principle (ϕ_1, ψ_1) is more important than a decision principle (ϕ_2, ψ_2) if the goal ψ_1 is more important than the goal ψ_2 [1][4].

Example 1. *Let us imagine an agent who wants to find an inexpensive hotel in which he can swim. This agent would also be happy to have free drinks but it is less important for him.* $\mathcal{V}_G = \{swim, free\_drinks, expensive, crowded\}$, *with* $pol(swim) = pol(free\_drinks) = \oplus$ *and* $pol(expensive) = pol(crowded) = \ominus$ *and* $swim \simeq expensive \succ free\_drinks \succ crowded$. *The possible pieces of information concern the following attributes:* $\mathcal{V}_F = \{pool, open\_bar, four\_stars, fine\_weather, special\_offer\}$. *The agent considers the following principles:* $\P = \{p_1 = (pool, swim), p_2 = (open\_bar, free\_drinks), p_3 = (four\_stars, expensive), p_4 = (fine\_weather, crowded)\}$. *When the weather is not fine then the fact that there is a pool is not sufficient to ensure that the agent can swim, it means that there is an inhibition on* p_1 *by* $\neg fine\_weather$, *and the DP* p_4 *that expresses that "if the weather is fine the hotel will be crowded" is inhibited when its a four stars hotel, and the DP* p_3 *is inhibited when the agent have a special offer, i.e.* $\mathcal{R} = \{(\neg fine\_weather, p_1), (four\_stars, p_4), (special\_offer, p_3)\}$.

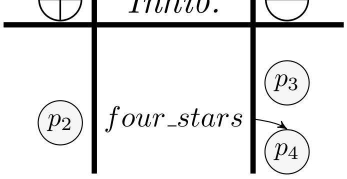


In order to make a generic BLF proper for evaluating specific decision alternatives, we introduce what is called a $\mathcal{K}$-valid BLF where $\mathcal{K}$ represents the knowledge base consisting of the attributes or features known to hold for the decision alternative. $\mathcal{K}$-valid BLFs can be thought to as a 'reduction' or 'projection' of the generic BLF to to 'valid decision principles' and 'valid inhibitors' which are, respectively, only those decision principles whose antecedents are contained in $\mathcal{K}$ and only those inhibitors which 'inhibit' these 'valid DPs'. These decision principles and inhibitors along with their associated polarity and level of importance give us a $\mathcal{K}$-valid BLFs [1].

Example 2. *The agent has the following information about a hotel represented by two knowledge bases:* $K_1 = \{\neg fine\_weather, pool, open\_bar\}$ *and* $K_2 = \{fine\_weather, four\_stars, open\_bar\}$. *From this we have two valid BLFs:* K_1*-Valid BLF and* K_2*-Valid BLF.*



K_1*-Valid-BLF*



K_2*-Valid-BLF*

A goal is said to be *realized* if it is contained in a decision principle that is not inhibited. The set of realized goals of different importance levels give rise to BLF semantics which define the admissibility status of decision alternatives [4].

In [1], Dupin de Saint-Cyr and Guillaume looked into the possibilistic treatment of BLFs. Possibility theory can be thought of as a qualitative response to imperfect knowledge about a set of possible worlds [2]. In relation to BLFs, the starting point is that a decision principles (ϕ, ψ) denotes that: it is more plausible that $(\phi \land \psi)$ holds than that $(\phi \land \neg\psi)$ holds [5]. An inhibitor is a link from an attribute ϕ' to a decision principle (ϕ, ψ). In the possibilistic framework, an inhibitor encodes the intuition that: in case that ϕ' holds, the 'inhibited' decision principle (ϕ, ψ) no longer holds [1].

As described above, inhibitors are observations that negate the validity of a default rule. It is natural to ask: what if an observation lends further credence to the validity of the default rule? How can this concept of 'support' be formalized and added to the BLF structure? What about the possibilistic terms of 'support'?

Thus far, both inhibitors and support are discrete entities in that they follow a 'all-or-nothing' approach which allows for no 'gradation' in the effect of support/inhibitors upon the decision principles. Consequently, instead of supports/inhibitors being discrete, we thought to conceptualize them as 'weighted' components where the weights associated with them represent the relative *strength/weakness* of the support/inhibitor. We will work to extend the possibilistic treatment of the BLFs to the notion of weighted supports and then to other BLF components and dynamics.

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April 11th, Argument Strength workshop, 9.00-17.30

09.00 - 10.00, Invited talk by Pietro Baroni

Strengthening argument strength

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Argument strength is a lively research subject attracting great interest and with many potential applications. A wide variety of approaches and studies are available in the literature and this richness of heterogeneous proposals represents a great opportunity but can also be regarded as carrying the risk that "strength" is perceived as a blurry term with different actual meanings.

The talk will discuss some possible investigation lines aimed at avoiding this risk and at strengthening the notion of strength in argumentation, along two main directions: a conceptual and formal classification of different notions of strength and the identification of some fundamental properties possibly common to any notion of argument strength.

Argument Strength as Degree of Purpose Achievement

Martin Hinton[1]

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In this presentation I consider the strength of an argument to be the degree to which that argument achieves or is likely to achieve the aims of the person putting it forward. The purpose is not to displace other conceptions of strength such as force of inference, weight of evidence, or power of persuasion, but rather to recognise that arguments may be employed for a variety of reasons, and one which may appear to be a poor, or weak, argument by the criteria listed above, may still be capable of having the effect desired by the arguer. To maintain this position it is necessary to accept a definition of argument which goes beyond the narrow confines of the 'critical discussion' stipulation in Pragma-dialectical theory [4] or even the wider concept of rhetorical argumentation [5]. Although it is often taken as read by argumentation theorists that the purpose of putting forward arguments in support of some standpoint or other is to persuade one's audience that those standpoints are, in fact, correct; and arguments are, therefore, essentially reasons to believe, a number of other ways of employing the techniques of argumentation have been suggested, such as in inquiry [3], and display of identity [1, 2]. When the purpose of entering into a discussion is to display one's identity, for instance, the persuasive force of any arguments one puts across is of little relevance compared to the degree to which that argument creates an understanding in one's interlocutors of the identity trait one wishes to convey. In this way, an argument put forward by a vegetarian might be a sincere attempt to persuade others not to eat meat, and its strength would then be measured (in some way) as a factor of its persuasiveness; but, equally, the vegetarian may be well aware of the hopelessness of such arguments with this particular audience, and instead use the techniques of argumentation to display the passion with which she defends her cause. In such a case, the strength of her arguments should be judged by the degree to which they express that passion, not the likelihood of their changing the behaviour or opinions of others. Another interesting group of cases is those where persuasion appears to be the goal on the surface of the exchange, but, in fact, hides the real intentions of the speaker. Examples of this are increasingly common in advertising, where more sophisticated campaigns eschew attempts at persuading the audience to buy their products and concentrate instead on building associations between certain values and a brand. The release of the annual Christmas television advertisement by the John Lewis chain has become something of an event in the UK in recent years. Each year the short film shows one aspect of Christmas, ending with a slogan. In 2013 'Give someone a Christmas they'll never forget'; in 2014 'Give someone the Christmas they've been dreaming of'; and in 2015, 'Show someone they're loved this Christmas', only in the last two years has the word 'gift' featured in the slogan. These films can be understood as attempts at rhetorical persuasion, giving reasons why we should behave as in the slogan, but the real purpose of such expensive advertising is not to make us show our love, but to make us associate the sentiment behind the argument with the brand, and only then, by association, to shop in their department stores. That association may come about no matter what the persuasive strength of the argument may be. This paper, then, will examine the idea that arguments can be used for purposes other than persuasion, and will suggest that in such cases judging their strength by their degree of persuasiveness would be perverse. Given the diverse nature of motivations for argument, no mechanism for calculating strength is suggested at this stage, what is argued for is the recognition of motivation when arguments are being evaluated, however that may be done.

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The strength of argumentative stories in Inference to the Best Explanation

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A common form of argumentation – in science, law, but also in everyday life – is Inference to the Best Explanation (IBE): given a set of observations, we assume a number of plausible alternative explanations and then look which one of these explanations best explains the observations. Such an explanation can be a simple proposition, but it can also be a more complex causal sequence of states and events, that is, a scenario or story. IBE has a clear dialectical component, in that alternative stories are essentially counterarguments: given an explanatory story S_1 it can be argued that there is another, different story S_2 that also explains the observations, and accepting S_2 will mean that S_1 is rejected and vice versa. There are more ways in which arguments play a role in IBE. For example, there might be other arguments that support parts of our story, such as arguments for a certain causal relation used in the story. Furthermore, new observations that contradict S_1 will lead to counterarguments to our story. This idea, that explanatory stories are essentially arguments in the wider setting of IBE, has recently been formalised [1, 2].

In IBE stories are typically compared according to how well they explain the observations. The basic idea is that the more observations that are explained by the story, the stronger the story. Similarly, we can say that the more observations the story contradicts, the weaker the story. These two measures of story strength, which we call coverage and contradiction, are relatively easy to quantify and compare. For example, we can look at set-theoretic measures (S_1 is stronger than S_2 if it explains a superset of observations), we can count the number of observations each story explains (more is better) or contradict (less is better), possibly taking into account that some observations are more important than others, and so on (cf. the work on decision making and argumentation such as[3]).

In addition to how well stories explain the observations, it turns out that stories also have a certain strength based on their internal *coherence*, which can be measured irrespective of the observations. With respect to coherence, we can consider *consistency* ("Is the story internally consistent?"), *completeness* ("Does the story have all its parts?") and *plausibility* ("Does the story conform to how we see the world around us?"). Consistency can be captured formally without appealing to any notion of strength, as an inconsistent story is essentially a self-defeating argument. For completeness and plausibility, however, we need the notion of story scheme.

Story schemes, which are similar to the well-known *scripts* from AI, encode world-knowledge as a a general pattern of (types of) events. For example, a "restaurant" script or scheme says that when visiting a restaurant, people normally take off their coat before having a seat and pay after they are done eating. Story schemes represent the ways in which we typically expect events to go, and while some deviation from the standard scheme does not directly make a story implausible (e.g., in a fast-food restaurant you pay before you eat), more serious deviations (e.g., the waiter takes off his pants and dances the funky chicken) make the story less believable and thus less strong. In fact, research [4] has shown that stories that adhere to common schemes are generally conceived off as more believable than stories which do not, irrespective of the actual observations in a case.

With the notion of a story scheme we can capture completeness and plausibility. The latter is the inherent plausibility of a story scheme or a part of the story scheme – this can be captured numerically, or different story schemes can be ordered according to how plausible we find them to be. Completeness then connects the story to the scheme: a story completes (part of) a scheme if the actual states or events in the story match the elements in the story scheme. We can then say that a story is stronger if it is more complete (i.e. all the events in the story are matched to essential elements of a scheme) and if matches a more plausible story scheme. The idea of story quality or strength has been formalised both logically [5] and probabilistically [6].

The aim is to explore two interesting directions. First, how can we incorporate the various notions of story strength in argumentation models of IBE? And second, what can we learn from the above notions of story strength for other types of argumentation? For example, story schemes have been likened to argumentation schemes. Does this mean that the plausibility of these schemes and the extent to which an argument completes a plausible scheme influence argument strength?

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Argument Strength: An Analysis of Linguistic and Pragmatic Parameters

Mathilde Janier[1], Marie Garnier[2], Patrick Saint-Dizier[3]

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Accurately evaluating the strength of a proposition P (also called a reason or a justification) that supports or attacks a claim in a real context is very challenging. This evaluation includes formal, linguistic and pragmatic factors which need to be accurately identified. The strength can be measured from a logical and pragmatic perspective or it can be measured from a language point of view. Both approaches are not necessarily coherent but they must be combined to produce a relatively accurate measure of strength. Strength must be measured for each proposition in isolation and then for groups of related propositions, taking into account their relations and structure.

In this contribution, we first identify linguistic phenomena and their related cues, including rhetoric cues, which are a priori marks of strength on arguments taken in isolation. We then integrate this analysis into a larger view where a proposition P is associated with discourse structures which may reinforce or weaken its intrinsic strength. In a subsequent stage, sets of related propositions P_i are considered, so that their relative strength can be characterized on the basis of linguistic factors.

Finally, the impact of argument schemes is discussed to give an overall picture of how argument strength based on linguistic and pragmatic analysis can be measured. Priority is given in this contribution to linguistic analysis, where results of lexical semantics are relatively stable, re-usable and accurate, over a more pragmatic and intuitive analysis of argument strength.

This analysis is carried out within the framework of argument mining where, given a claim, propositions P for or against this standpoint are mined in different types of texts (see for example [11])). Besides supporting or attacking the standpoint, propositions P may also attack or support each other. The problem of relatedness has been addressed in [16], it will therefore not discussed in this contribution which focuses on a crucial and difficult parameter: evaluating the potential strength of an argument. Finally, in our perspective, persuasion is a kind of contextual evaluation of the strength of an argument. This will not be addressed here, although it is clear that it should be the ultimate component of such an investigation.

Investigations on argument strength have focused on a few aspects such as (1) teaching how to organize written essays and how to organize arguments and give them an appropriate visibility, (2) research on persuasion which is, in our view, an analysis of strength in contexts (domain and listeners are taken into account), and (3) in theoretical analysis of argumentation where graphs of attacks and supports are developed. Let us note for example [8] that deals with an in-depth analysis of persuasion, [21] which investigates the content of persuasive messages. Sensitivity to argument strength of various populations is developed in e.g. [3]. The relation of strength with rhetorical questions has been addressed in e.g. [13] A number of linguistic factors are analyzed in e.g. [1], and later in [5]. However, to the best of our knowledge little has been done to characterize argument strength from a linguistic point of view, in a practical way and within the perspective of argument mining. This article is a contribution to this perspective, it also outlines the high context sensitivity of linguistic factors.

This contribution is organized as follows:

- In a first stage, the contribution to argument strength of individual lexical items found in propositions for or against a claim is investigated. Lexical semantics structures to organize them are introduced. There are many elements which may have an impact on strength. Those with a higher impact are head elements such as verbs, and elements which are less prominent in the syntax such as evaluative adjectives and adverbs.

- The expression of strength is also mediated by a number of terms which introduce the proposition. These are called **control constructions**, they sub-categorize for a proposition or a sentential complement. Their scope is the entire argument.

- The combinations of various linguistic structures that induce strength is then explored and leads to the definition of a **strength signature**. Argument specific annotations are then provided.
- Besides an a priori linguistic evaluation, the strength of these expressions and their combinations are explored experimentally from a corpus. Results are integrated into our strength model.
- Influence of discourse structures on argument strength: arguments are quite frequently associated with elements such as comments, elaborations, comparisons, illustrations, etc. which can be considered as either forms of explanation or secondary or subordinated arguments. These structures frequently have an impact on strength, they may also implement argument schemes as shown in [18].
- Another component is the inner structure of the argument and its underlying scheme. (Walton et ali, 2008)[19], (Parsons et ali. 2008)[14], have identified and structured a large number of schemes which are used in everyday argumentation. Some of them can be detected via a linguistic analysis [7, 9]. These can provide information on the strength of arguments. A number of schemes among the most frequently encountered are discussed in this presentation w.r.t. strength evaluation.

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Resources:
Sentistrength (`http://sentistrength.wlv.ac.uk/`)
the Stanford Sentiment Treebank.

Computing Argument Strengths Using Simplicity Theory

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The strength of arguments is often pre-stored in attack relations. This is acceptable in situations in which the range of possible arguments can be anticipated. However, the ambition of dialogue systems is eventually to compute arguments on the fly that are appropriate for a variety of contexts that may be wide or even unbound. This paper shows how Simplicity Theory (ST) may offer theoretical means to compute the dialogic impact of arguments dynamically.

ST has been introduced to account for the relevance of utterances. In the context of argumentation, one way for a statement (or argument) to be relevant is to introduce a logical contradiction with the current state of beliefs and desires, as established by preceding utterances from the conversational context and underlying background knowledge. For instance, mentioning the presence of termites is a good argument against building a wooden chalet at that location. The strength of the argument in this case can be measured by that of the weakest epistemic or epythimic commitment—or, as quantified in ST, the smallest "necessity"—associated to the terms of the contradiction (e.g. the "necessity" of choosing that location, or the "necessity" that the chalet is made of wood, or the "necessity" of the presence of termites).

ST offers ways of computing "necessity" by combining *desire intensity* with *unexpectedness* (for an operational definition of unexpectedness, see `www.simplicitytheory.science`). For instance, given the presence of termites in the region, their absence at the building location would be both unexpected and desired. "Necessities" may change dynamically throughout argumentation when new evidence is brought or when desire intensities are modified. ST has been also used to compute responsibilities by propagating (often negative) desires from consequences to causes. These computations take the unexpectedness of causes and the unexpectedness of causal links into account. We propose to apply a similar computation to assess the strength of arguments. By making "attack" a notion derivative of argumentative pertinence, our approach unveils a method to perform a cognitive step left implicit in formal argumentation frameworks.

14.00 - 15.00 Invited talk by Leila Amgoud

Evaluation of arguments: Axiomatic foundations and methods

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TBA

Strength of argument against attack in the context of information input

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Theme: argument strength is not numerical of any sort but is logical robustness against attacks in the context of the attack as information input.

Claim 1: What is commonly known as numerical strength is not strength but should be viewed as just a label to be used in computing extensions. The framework in which to model the variety of strength of attack models in the current literature is LDS (Labelled Deductive Systems)

To remind you, the idea of LDS is to replace the declarative unit of say propositional logic (such as the wff A), by a declarative unit with a label (such as $t : A$) where the label comes from some algebra or another logic. The label can represent additional information from the meta-level which is brought into the object level. Then instead of manipulating basic units of the form "A" we manipulate basic units of the form "$t : A$".

Applying this recipe to formal Dung argumentation , we look at a directed graph (S, R) whose basic units are elements a in S and (x, y) in R, so these become $t : a$ and $s : (x, y)$, or graphically $a1 \to a2$ is replaced by $(t1 : a1) \to$s $(t2 : a2)$ We can get an idea of how to manipulate such networks by translating it to LDS version of classical logic. This is the methodology of "logic by translation" Few principles are immediately clear. 1.1 the labels can also be attacked , they are part of the declarative unit 1.2 the labels could be anything logical/mathematical such as numerical value, probability, another argument, a database, a logical theory, time, source etc even an entire argumentation network 1.3 And the process can be iterated, labels of labels etc. All as is done in my books LDS (OUP 1996) and fibred semantics (OUP 1998). 1.4 A complete extension is a set of declarative units ,in other words labelled arguments 1.5 I admit this is very general but it can be tailored for what we want for argumentation. Claim 2 Argument strength is logical robustness facing attacks as logical input. It is best handled within a framework of evolving temporal argumentation

This is best explained by an example X: I am not a sex offender B: X was seen groping his secretary

Clearly in the above state of information we have that B attacks X X defends himself, saying X':

X': My secretary is my wife

Clearly $X + X'$ attack B.

However, B does not let go and checks the employment records and continues with B':

B': the secretary is not registered or reported as X's wife

Clearly B' attacks X', To this X answers with X'':

X'' : The secretary is indeed my wife. I kept it a secret because It is a tax dodge, there is less tax deduction for my wife's employment. So I am not a sex offender, just a tax dodger.

Clearly X'' attacks B'

The above exchange of attacks is a case of information input. Note that $X + X' + X'' + B + B'$ are all consistent together

There is the question of how to model this, with or without labels, but this is not important here. The more relevant is to the question of strength of attack 2.1 clearly information input can be an attack. (it can also be support depending on the context , see my paper on information input) 2.2 the strength of argument is dynamic and depends on Robustness relative to possible new information coming. Let me give you an example from an idea of the Phd Thesis of my student Sanjay Modgil I say ($*$) All insurance salesmen are crooks. To attack ($*$) and defeat it you need the information input of one counter example. Smith is an honest insurance salesman. Sanjay will deal with this turning ($*$) into a defeasible rule and say that Smith is an exception. The fact is that ($*$) considered as a defeasible rule is very strong. The more you give me counterexamples the more I say this is an exception. To really kill this rule maybe I need to record the all the licensed insurance salesmen and all the exceptions. Think of an argument that the prime minister should resign because of a scandal. The strength of an argument in politics fades in time. Survive the next few days and you are ok.

Ten arguments concerning strength in abstract argumentation

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Ten arguments concerning strength in abstract argumentation

Leon van der Torre

Argument 1.

Values play a more important role in formal argumentation than in related KR formalisms.

Background. With related KR formalisms I refer to logic programming, epistemic logic, default logic, causal theories, preference logics, deontic logic, and so on. I do not refer to theories originating from economics like theory of decision, game theory, social choice, and so on.

Reason 1. In a common sense theory, argumentation is a process of weighing pro and cons reasons concerning an issue, similar to the model of multi criteria decision making. This is in particular explicit in legal argumentation. Consequently, without values representing the strength of argument/attack, it is quite difficult if not impossible to model real world examples of argumentation in a realistic way.

Reason 2. Argumentation lacks purely qualitative mechanisms adopted in other areas, such as the specificity principle.

Reason 3. Strength of argument/attack is of central importance in the abstract theory of formal argumentation, as it is the main reason explaining why attack is directional and not symmetric (other reasons are e.g. violating assumptions, undercutting of arguments and ad hominem attack).

Argument 2. In a regular Aspic+ style setting, strength is a comparative notion. In other words, strength of an argument depends on the context of other arguments.

Background. At the first workshop on strength of argument in Bochum, I argued that the strength of an argument does not exist, in the sense that fixed values cannot be associated to each argument, such that these values determine whether the arguments defeat each other. Instead, values in abstract argumentation have to depend on both arguments, the attacker and the attacked. I argued this using the following example, an extension of an example provided by Young in his recent PhD thesis.

Reason. Consider weakest link=greedy and the atomic derivations (or rules) a/b:1, b/c:2, b/-c:3 and facts a. In this case, the relevant arguments are abc:12 and ab-c:13 and the latter defeats the former. Now consider derivations a/b:1, b/c:2, b/-c:3, a/c:2 and facts a. In this case, the arguments are abc:12, ab-c:13, ac:2 and the third argument defeats the second one (and the first one is reinstated). For example, in Young's approach the strength of ab-c:13 is 3 when compared to abc:12, and 1 when compared to ac:2. Attributing fixed strengths (or priorities, or probabilities, etc) to arguments thus is too restrictive.

Argument 3. We should define strength of attack instead of (or in addition to) strength of (abstract) arguments.

Background. Rejecting the notion of attributing strengths to arguments as the sole representation of strength in argumentation, we can attribute a strength to attacks, which can be derived from the logical structure of the arguments.

Reason. Follows from argument 2.

Argument 4. To evaluate the impact of strength of attack on the acceptance of arguments, we need to know the type of attack (e.g. rebutting, undercutting, undermining, ad hominem, etc).

Reason. In the binary case, attack just means that acceptance of the attacker implies rejection of the attacked. With strength of attack, however, an accepted attacker may not be strong enough to reject the attacked argument. To decide whether an attack is strong enough, we need to know more about the kind of attack.

Argument 5. Strength of attack can be studied using attack semantics. This means that we evaluate the impact of strength of attack on the success of the attack.

Background. Note that in his PhD thesis, Young uses the ASPIC+ framework of instantiating arguments. Also the other mainstream theories of structured argumentation instantiate arguments.

The attack semantics of Villata et al (IJCAI11) suggests that alternatively, we can instantiate attacks instead of arguments.

Reason. In such a structured theory instantiating attacks, the concept of strength of attack could be defined more naturally than in an ASPIC+ based theory.

Argument 6. The difference between traditional (Informal) argumentation and abstract argumentation is the evaluation of individual arguments. To incorporate both traditions, Dung's graph based formalism of abstract argumentation should be extended with an evaluation function of individual arguments.

Background. To understand the nature of strength in abstract argumentation, we need to better understand abstract argumentation itself. Dung emphasized the role of abstract argumentation as a general framework for non-monotonic reasoning, but he does not explain the relation with informal argumentation.

Reason. As explained by Amgoud during an invited talk last year in Belgrade, traditionally the acceptance of an argument depends only on the logical structure and content of the argument itself. In Dung's abstract argumentation, the acceptance of an argument is completely determined by the relation between the argument and other arguments, the acceptance or rejection of the other arguments, and the argumentation semantics. Amgoud therefore proposed that Dung's graph based formalism of abstract argumentation should be extended with an evaluation function of individual arguments.

Argument 7. There is a natural interpretation of abstract argumentation that does not involve an evaluation of individual arguments.

Reason. From the perspective of dialogue, the core idea of Dung's abstract argumentation can be rephrased as follows. When someone likes to criticize an argument A, it is no longer sufficient to point at deficiencies in the argument A itself, but one has to formulate another argument B that makes this criticism explicit. The advantage of making the criticism explicit as an argument B is that the critical argument B itself can be criticized as well. Thus, one can formulate an argument C attacking argument B, and reinstating argument A. And so on. This is a counter-argument against introducing an evaluation function for individual arguments.

Argument 8. If all criticism of an argument has to be phrased as an argument itself, we cannot restrict arguments to logical derivations, as in ASPIC+ and related theories of structured argumentation.

Reason. Considering the variety of critical questions that can be raised against common argument schemes, it seems that a much richer notion of argument is called for.

Note. Thus far I argued that strength in abstract argumentation is a comparative notion, and that a so-called dialogue perspective on abstract argumentation can be defined without taking an evaluation of individual arguments into account. But does this dialogue perspective bring some insight to the notion of the idea of strength of attack? As always, the question is how to interpret SCC such as cycles in a uniform way.

Argument 9. Arguments can fruitfully be modeled as processes and in particular give a natural and intuitive interpretation of the strength of attack.

Background. Current conceptualizations of arguments give a static interpretation of both arguments and argumentation frameworks, or a static interpretation of arguments and a dynamic interpretation of frameworks. Examples of the latter are dialogue based decision procedure of argumentation semantics, and the change of argumentation frameworks due to changing knowledge bases. Barringer, Gabbay and Woods in 2005 already gave temporal dynamics of graphs and some examples (e.g. predator prey models) and Arisaka suggests a dynamic interpretation of arguments themselves (e.g. as agents). Thus, arguments are abstractions from argument processes, and relations between arguments are a process coordination mechanism. Argument processes may or may not be autonomous, like agents.

Reason. Strength of attack can be naturally defined as the effect of one process on another process.

Reason. The dynamic interpretation of arguments implies that arguments have a behavior that can change over time, and that this behavior can depend on input and generate output, like the observations and actions of agents. Attack relations among argument processes can be understood as relations between output and input of argument processes.

Reason. Note that this explains also Gabbay argumentation fibring, I.e., how an argument itself can be an abstraction of an argumentation framework. (See also Arisaka and Dauphin, submitted).

Argument 10. A principle based approach is called for

Background. A principle based approach defines general principles (or properties, or desiderata, or axioms, or postulates, or requirements). Thus, consider a function f from (A,R,sA,sR) to sets of subsets of A, where (A,R) is a Dung framework, sA and sR are functions assigning values to A and R, and the subsets of A are the extensions of the argumentation framework. A principle based approach defines constraints on the function f. For example, a higher strength of an attack cannot make a successful attack unsuccessful (in terms of attack semantics).

Reason. There is a lack of consensus on the strength of argument/attack, and a principle based approach can describe properties of strengths of arguments and attacks at a higher level of abstraction.

April 12th, Argument Strength workshop, 9.00-17.00

09.00 - 10.00, Invited talk by Francesca Toni

How Many Properties Do We Need for Gradual Argumentation?

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The study of properties of gradual evaluation methods in argumentation has received increasing attention in recent years, with studies devoted to various classes of frameworks/methods leading to conceptually similar but formally distinct properties in different contexts. In this paper we provide a systematic analysis for this research landscape by making three main contributions. First, we identify groups of conceptually related properties in the literature, which can be regarded as based on common patterns and, using these patterns, we evidence that many further properties can be considered. Then, we provide a simplifying and unifying perspective for these properties by showing that they are all implied by the parametric principles of (either strict or non-strict) balance and monotonicity. Finally, we show that (instances of) these principles are satisfied by several quantitative argumentation formalisms in the literature, thus confirming their general validity and their utility to support a compact, yet comprehensive, analysis of properties of gradual argumentation.

How not to aggregate reasons

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Assume an arguer forwards two reasons, R1, R2, in support of a claim, C. Further, assume the meanings of R1 and R2 neither exhaust, nor fully include, the meaning of C. This makes the argument "R1 and R2, therefore C" an instance of ampliative reasoning, and so projects onto inductive inference.

As an a priori truth, if R1 and R2 provide some positive support for C, then the support that R1 lends to C either does, or it does not, depend on the support that R2 provides, and vice versa. The case where reasons provide negative support (of the undermining or undercutting kind) is analogous. In principle, factual and normative reasons (or evidence) can be treated alike [1].

Abbreviating 'support' by 'P', as in 'probability', we can hence express "How do reasons aggregate?" as "How to define P(C—R1@R2)?", where '@' denotes the concatenation of R1 and R2. Raising this question, then, is to ask how we might specify the function f(P(R1), P(R2)).

There is no shortage of candidates for this. One candidate is the "weakest link principle" (or Theophrastus' rule) according to which f(P(R1), P(R2)) outputs the minimum value of P(R1) or P(R2). A second (related) candidate selects the maximum of both values. A third settles for some value below the maximum (e.g., the multiplicative sum, P(R1)×P(R2), or the average sum, P(R1)+P(R2)/2, or a weighted combination thereof). The fourth candidate, finally, sends f(P(R1), P(R2)) to values above the maximum.

The four options are exhaustive. Hence, we can express both positive and negative support along whichever scale measures the strength of the 'is a reason for'-relation. Following Spohn's (2012) [3] ranking theory (see [4]), therefore, we can define the most general scale as:

$$+\infty \geq P(C—R1@R2)=f(P(R1), P(R2))=P(C—R1)+P(C—R2)\times a \geq -\infty$$

where a (being some rational number) is an "aggregation term" that, if suitably selected, specifies one of the above four candidates. What many today call a Bayesian (or Pascalian) approach to probabilistically calculating argument strength (e.g., [2], itself defined over the interval between 0 and 1, is a limiting case of the above Baconian scale. Of course, important differences between a Pascalian and a Bayesian approach [5] can arise from defining rules that relate P(C—R) with P(nonC—R), which are co-dependent terms in the former approach, but not in the latter.

We briefly review—yet criticize—approaches that define f(P(R1), P(R2)) according to the structural linked vs. convergent vs. serial distinction. In particular, a probabilistic perspective lets a serial (aka subordinate) structure appear as a non-distinct instance of a linked structure. The two basic structures, then, are the linked and convergent structure.

We also explain why the four aggregation-candidates (rightly) apply to some natural language arguments. Decisive reasons to favor this or that candidate, however, not only cite, but indeed pivot on semantic rather than structural information. Which structure properly models reasons R1 and R2, and which candidate properly aggregates them, therefore stands or falls with the dependence or independence of the sematic contents these reasons express.

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Strength-Based Semantics for Abstract Argumentation

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Argument evaluation has been the object of much research in the argumentation community since [3], with the definition of two families of semantics: extension-based semantics, returning sets of arguments that can be accepted together, called *extensions*, and ranking-based semantics, assigning an acceptability degree to each argument, leading thus to a ranking over the set of arguments [1]. However, the expressive power of these semantics is insufficient in some applications, e.g., decision-making, normative reasoning, where the strength of an argument also depends on exogenous aspects like the authority of its source, its content, or the number of people endorsing it.

We propose a new graded semantics, called *strength-based acceptability semantics* $\mathcal{S}$, which computes the acceptability degree of an argument considering both its strength degree and the acceptability degree of the arguments attacking it in the framework. We present a triangular norm-based multi-valued logical framework to manipulate argument acceptability such that we may regard argument acceptability as taking truth values in $[0, 1]$.

The fundamental assumption we make is that arguments have a *strength*, which, whatever its interpretation, can be represented as a value in the $[0, 1]$ interval, with 0 corresponding to no strength at all, and 1 corresponding to the full or maximum strength. Given an argument a, we will denote its strength by $s(a)$.

The strength of an argument may be the result of different considerations relevant to the application scenario, e.g., it might depend on: (1) its internal structure—the validity of the inference pattern to check the tenability of the claim; (2) its social consensus (e.g., the number of favorable and unfavorable votes [4]); (3) the authority of the source (or the "reasoner") offering it [2]; such authority may be a measure of the reliability of the source, like competence, expertise, trust, reputation, and the like.

Definition 6. *A strength-based argumentation framework is a triple $SBAF = \langle \mathcal{A}, R, s\rangle$ where $\mathcal{A}$ is a finite set of* arguments*, $R \subseteq \mathcal{A} \times \mathcal{A}$ is a binary relation called* attack*, such that $(a, b) \in R$ iff a attacks b, and $s : \mathcal{A} \to [0, 1]$ is a total function which assigns a* strength *to each argument.*

This association of strengths to arguments suggests rethinking the argumentation semantics in terms of degrees of argument acceptability. Instead of dividing arguments into accepted, not accepted and, possibly, undecided, we may regard argument acceptability as taking truth values in $[0, 1]$, and then use a triangular norm-based multi-valued logical framework to manipulate them. A graded acceptability semantics for an argumentation framework $AF = \langle \mathcal{A}, R\rangle$ may be defined as a weighting function $\alpha_{AF} : \mathcal{A} \to [0, 1]$ which assigns to every $a \in \mathcal{A}$ its acceptability degree $\alpha_{AF}(a)$.

Definition 7. *Let $SBAF = \langle \mathcal{A}, R, s\rangle$. The strength-based acceptability function is a total function $\alpha : \mathcal{A} \to [0, 1]$.*

Such an α may also be regarded as the valuation function which assigns a truth degree to each proposition of the form "argument a is acceptable". Accordingly, $\alpha(a) = 0$ means the argument is outright unacceptable, $\alpha(a) = 1$ means the argument is fully acceptable, and all cases inbetween are provided for.

To define the fundamental postulates of the strength-based semantics, we have to reinterpret in a many-valued logical framework the requirement that, in order for an argument a to be accepted, accepted(a):

- no argument b attacking a should be accepted:

$$\text{accepted}(a) \Rightarrow \forall b : (b, a) \in R, \neg\text{accepted}(b). \quad (1)$$

  This is, indeed, a reformulation of two basic concepts in admissibility-based semantics: *(i)* an argument a belongs to an extension X if and only if each defeater of a (if any) is defeated by an argument in X (i.e., defense), and *(ii)* there does not exist any argument $a, b \in X$ such that b attacks a (i.e., conflict-freeness);

- an argument may only be accepted if it is *strong*:

$$\text{accepted}(a) \Rightarrow \text{strong}(a). \tag{2}$$

The combination of these two necessary conditions gives us a necessary and sufficient condition for a to be accepted:

$$\text{accepted}(a) \equiv \text{strong}(a) \wedge \forall b : (b, a) \in R, \neg\text{accepted}(b). \tag{3}$$

By defining $s(a) = \tau(\text{strong}(a))$ and $\alpha(a) = \tau(\text{accepted}(a))$, interpreting the above condition in a triangular-norm-based many-valued logic yields

$$\begin{aligned}
\alpha(a) &= \tau(\text{accepted}(a)) \\
&\quad \text{[by Equation 3]} \\
&= \tau(\text{strong}(a) \wedge \forall b : (b, a) \in R, \neg\text{accepted}(b)) \\
&\quad \text{[by the definition of } \tau(\phi \wedge \psi)\text{]} \\
&= T\left(\tau(\text{strong}(a)), \tau(\forall b : (b, a) \in R, \neg\text{accepted}(b))\right) \\
&\quad \text{[by the definition of } \tau(\forall x \phi(x))\text{]} \\
&= T\left(s(a), \underset{b:(b,a)\in R}{T} \tau(\neg\text{accepted}(b)\right) \\
&\quad \text{[by the definition of } \tau(\neg\phi)\text{]} \\
&= T\left(s(a), \underset{b:(b,a)\in R}{T} 1 - \tau(\text{accepted}(b)\right) \\
&\quad \text{[since } \alpha(b) = \tau(\text{accepted}(b))\text{]} \\
&= T\left(s(a), \underset{b:(b,a)\in R}{T} 1 - \alpha(b)\right) \\
&\quad \text{[since } T \text{ and } S \text{ are a dual pair]} \\
&= T\left(s(a), 1 - \underset{b:(b,a)\in R}{S} \alpha(b)\right).
\end{aligned}$$

We thus obtain the following definition of a legal strength-based acceptability function.

Definition 8. *Let α be a strength-based acceptability function. We say that α is* legal *iff, for all arguments $a, b \in \mathcal{A}$,*

$$\alpha(a) = T\left(s(a), 1 - \underset{b:(b,a)\in R}{S} \alpha(b)\right). \tag{4}$$

We can verify that the strength-based acceptability function is a generalization of classical argumentation semantics, i.e., an argument a is *accepted* when $\alpha(a) = 1$, and an argument a is *rejected* when $\alpha(a) = 0$. Between these extremes, there are infinitely many degrees of partial acceptance.

The main advantage of the presented approach is its generality: on the one side, both endogenous and exogenous information can be conjointly taken into account to compute the overall acceptability degree of the arguments if the application scenario requires it, but, on the other side, if only the structure of the argumentation framework is demanded, our approach is still valid, under the assumption that all arguments are assigned with the same strength.

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A Walk Through a Hidden Zoo. Argument strength/s - semantics and principles

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Already in their early days, structured and abstract argumentation have exploited preference relations between arguments. On one hand, they allow to encode information about the perceived relative strength of arguments. On the other hand, they help to implement the idea of asymmetric conflicts. More recently, quantitative approaches considering actual strength valuations have enjoyed increasing interest (see our workshops ...). Such a refinement has several advantages. First, it paves the ground for a more fine-grained modeling of real-world debates. Secondly, it permits to compare relationships between arguments within and across argumentation contexts. Thirdly, it provides a tool to prioritize extensions, or to produce more informative graded extensions. Last but not least, it allows to better judge the plausibility of argumentative consequences. To realize a more thorough analysis and obtain a more coherent picture, one may in addition (to the ordering) introduce a suitable algebraic structure over the value domain. However, to reap the benefits of such extended formal models, one needs a much better understanding of what is meant by argument strength, and how it relates to other argumentation-theoretic concepts like attack, sup- port, defeat, extensions, and justifications. For instance, it is not enough to attach in an ad hoc manner numbers to abstract atomic arguments and naively assume that, for conflicting ones, they would automatically determine the direction of attack. Depending on how we interpret arguments and their strength characteristics, a higher value by itself may not always justify defeat. Furthermore, for structured arguments, there are many (also combinable) ways to specify strength, based e.g. on the premises, the implicational arrows, the inference steps, the inference tree, implicit or explicit conclusions, syntax or semantics, which may well produce highly diverging results. And then, where do the numbers come from? This is not just the question of how we may associate with them an - ideally operationalizable - meaning, but also whether our standard semantics, e.g. partly relying on preference-based argumentation, generate inferences compatible with inferential intuitions about prototypical examples, and especially, whether the chosen numberings are coherent to begin with. The goal of the present contribution is therefore to provide a more systematic investigation of the notion of argument strength, or more modestly, to realize a little walk through the darker zones of the zoo of strength concepts, trying to see how they relate and which properties they may - and should - satisfy. Our basic instrument will consist of a powerful semantic framework, not primarily aimed at identifying extensions but at interpreting defeasible arguments and attack/support notions. More specifically, because reasonable structured logic-based arguments typically have to rely on defeasible implications/rules, we will exploit and apply the sophisticated ranking measure semantics for default conditionals and default inference notions based on and extending earlier work. An advantage of this approach is that it supplies in the background well- motivated quasi-probabilistic plausibility valuations, an independence concept, and numerous well-investigated and justified defeasible inference methods. These can be used to specify structured arguments, to interpret abstract ones, or to evaluate argumentation-theoretic reasoning. In addition they offer a necessary bridge towards other KR-formalisms. In previous work, we have illustrated the potential of such a semantic account by presenting a new extension semantics based on ranking measures. Here we will however adopt a different and much broader perspective focusing on variants of numerical argument assessments related to strength. A characteristic of this framework for argument and argumentation semantics is that it can by itself produce well-justified quantitative assessments of arguments even if the initial specifications are purely qualitative. When dealing with explicit strength, either on the input or on the output side, one may just have to enter additional value parameters - but the theoretical machinery stays the same. The anchoring in a deeper semantic environment also guarantees more flexibility. For instance, it makes it easy to satisfy the demands of some authors (cf. abstract of van der Torre) which call for attack strength when the strengths of the conflictual arguments alone are no longer sufficient. Besides listing and looking at several innovative notions of argument strength, we will also consider and evaluate existing principles for grading arguments or chararacterizing reasonable strength concepts. However, while postulates can sometimes be useful for filtering out inadequate approaches and guiding re- search, without a proper understanding of the existing diversity, for instance the existence of distinct, complementary concepts running under the same name, there is a risk of misguidance. Also, as one may see in iterated belief revision and for nonmonotonic meta-level default inference (not default conditionals), syn- tactic principles are rarely sufficient, or practical, to identify the best available semantic accounts. Nevertheless, they can still provide minimal requirements, classifications, point to similarities, and thereby help to improve our grasp of the different faces of argument strength.

14.00 - 15.00, Invited talk by Anthony Hunter

Introduction to Probabilistic Argumentation

Anthony Hunter[1]

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Argumentation can be modelled at an abstract level using an argument graph (i.e. a directed graph where each node denotes an argument and each arc denotes an attack by one argument on another). Since argumentation involves uncertainty, it is potentially valuable to consider how this can quantified in argument graphs. In this talk, we will consider two probabilistic approaches for modeling uncertainty in argumentation. The first is the constellation approach which involves a probability distribution over the subgraphs of the argument graph, and this can be used to represent the uncertainty over the structure of the graph. The second is the epistemic approach which involves a probability distribution over the subsets of the arguments, and this can be used to represent the uncertainty over which arguments are believed. The epistemic approach can be constrained to be consistent with Dung's dialectical semantics, but it can also be used as a potential valuable alternative to Dung's dialectical semantics. We will also consider empirical studies undertaken with participants that support the case of both the constellations and epistemic approaches.

Cognitive Aspects of Formal Argumentation – Challenges and Progress

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Formal (abstract and structured) argumentation theory has led to many interesting formalisms, whose formal properties have been studied in detail. Mostly these formalisms are motivated by certain considerations about the human practice of argumentation or related practices like that of defeasible reasoning. To find out whether there is a real connection between these formalisms and actual argumentation, purely formal work will not suffice: It is necessary to do empirical work about human argumentation that tests whether the way people use and evaluate arguments has anything to do with the formalisms of formal argumentation theory. Until recently, such work was very rare, one exception being Rahwan et al.'s (2010) study that tested and compared how people evaluate simple reinstatement and floating reinstatement.

At the University of Luxembourg, we are currently working on Cognitive Aspects of Formal Argumentation, an interdisciplinary project that brings together AI researchers and cognitive scientists in order to perform empirical studies on how humans actually understand and evaluate natural language arguments, and how this relates to general assumptions of formal argumentation theory as well as features of specific argumentation semantics. So far we have performed three empirical studies in this directions, on whose results we will report in this talk.

The first two studies, one performed with experts in formal argumentation theory and one with non-expert participants (undergraduate students), focused on the link between sets of natural language arguments and argumentation frameworks. While the non-directed notion of conflict between two arguments is relatively clear even in natural language arguments, the directionality of attacks between natural language arguments is much less clear. For example, Rahwan et al.'s (2010) study assumed certain attacks to be unidirectional, but our first two studies show that both a majority of experts and a clear majority of non-experts view them as bidirectional.

In our third study, the participants (undergraduate students) were first given some basic explanations of what an attack between arguments is, and were shown the three distinct AFs of size 2 as examples for how the existence and directionality of attacks influences judgements about the acceptance and rejection of arguments. They were then shown a set of three to five natural language arguments, and had to first draw the corresponding AF, and then make judgements about which arguments they accept, which ones they reject, and for which ones they are undecided. One goal was to test whether people follow the principle of reinstatement at least in the case of a simple reinstatement. Another goal was to test whether the judgement of participants in the second part correspond to the sceptical or credulous judgements over one of the standard argumentation semantics (grounded, sceptical/credulous preferred or sceptical/credulous CF2; the design of the study did not allow to make a more fine-grained analysis distinguishing even more semantics).

For designing the sets of natural language arguments to be used in this study, we used the results of the first two studies to have control over which AF participants are likely to draw. For the simple AFs of size 3, this worked well, but for the more complex AFs of size 4 and 5, the rate of deviation from our intentions was much higher. For this reason, the AF of size 5 intended to allow to distinguish sceptical preferred judgements from or sceptical CF2 judgements was only rarely drawn. Nevertheless, the study could establish some noteworthy results:

- People mostly do follow the principle of reinstatement in the case of simple reinstatement.
- For evaluating the type of arguments considered in the study, people do not use grounded semantics and do not make a credulous judgement over any of the standard semantics.

The results do not yet allow to conclude whether the judgements of people on this type of arguments predominantly coincides with sceptical preferred judgements, sceptical CF2 judgements, some other sceptical judgement over a standard semantics, or some form of judgement not yet considered in the literature.

Our empirical work on argumentation theory has brought to light some of the challenges that such work necessarily faces, but that have been underestimated or even completely ignored by previous empirical studies on argumentation theory. So, additionally to presenting our findings, we will also discuss these challenges and possible solutions to them, in order to help future researchers to tackle these challenges more efficiently.