A bipolar argumentation-based decision framework

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Abstract

The paper emphasizes the *bipolar* nature of the evaluation of decision results by making an explicit distinction between prioritized *goals* to be pursued, and prioritized *rejections* that are stumbling blocks to be avoided. This is the basis for an argumentative framework for decision. Each decision is *supported* by arguments emphasizing its positive consequences in terms of goals satisfied, or rejections avoided by that decision. A decision can also be *attacked* by arguments emphasizing its negative consequences in terms of missed goals, or rejections reached by that decision.

Thus, such bipolar setting provides a *richer typology* of arguments, and consequently rich principles for comparing decisions. We will show also that such a setting allows not only comparing decisions, but also defining the *status* of each decision. Four main status are distinguished: *recommended* decisions, *discommended* decisions, *controversial* decisions and finally *neutral* decisions.

The paper presents a unified logical *argumentation-based model* in which different decision processes (decision under uncertainty, multiple criteria decision, and rule-based decision) are captured.

Keywords: Decision, Argumentation.

1 Introduction

Humans use arguments for supporting, attacking or explaining decisions. Indeed, each potential choice has usually pros and cons of various strengths. Adopting such an approach in a decision support system would have some obvious benefits. On the one hand, not only would the user be provided with a "good" choice, but also with the reasons underlying this recommendation, in a format that is easy to grasp. On the other hand, argumentation-based decision making is expected to be more akin with the way humans deliberate and finally make a choice. Indeed, the idea of basing decisions on arguments pro and cons is very old and was already somewhat formally stated by Benjamin Franklin [9] more than two hundreds years ago.

The idea of articulating decisions on the basis of arguments is relevant for different decision problems or approaches such as decision under uncertainty, multiple criteria decisions, or rule-based decisions. These problems are usually handled separately, and until recently without a close reference to argumentation. In practical applications, for instance in medical domain, the decision to be made has to be chosen under incomplete or uncertain information, the potential results of candidate decisions are evaluated from different criteria. Moreover, there may exist some expertise under the form of decision rules that associate possible decisions to given contexts. This makes the different decision problems somewhat related, and consequently a unified argumentation-based model is needed.

This paper aims at proposing such a unified logical argumentation-based model. The advantages of a logical view of decision include a unified treatment of multiple criteria decision, decision under uncertainty, together with explanation capabilities. Whatever the decision problem is, the basic idea is that candidate decisions may lead to positively or negatively assessed results. This gives birth to arguments in favor of or against a decision in a given context.

The paper emphasizes the *bipolar* nature of the evaluation of decision results, by making an explicit distinction between *goals* having a positive flavor, and rejections, with a negative flavor, that are stumbling blocks to be avoided. This, for instance, applies to criteria scales where the positive grades (associated with positive results) are separated from the negative ones (associated with negative results) by one or several neutral values.

The general class of decision problems considered here consists in rank-ordering a set of mutually exclusive decisions on the basis of sets of goals and rejections of various importance, of background knowledge, and of factual information describing what is known about the context in which a decision should take place.

Thus, such bipolar setting provides a *richer typology* of arguments, and consequently rich principles for comparing decisions. We will show also that such a setting provides not only elements for comparing decisions, but also defines the *status* of each decision. Four main status are distinguished: *recommended* decisions, *discommended* decisions, *controversial* decisions and finally *neutral* decisions.

2 Argumentation-based decision framework

In what follows, let $\mathcal{L}$ be a propositional language. From $\mathcal{L}$ we can distinguish the five following sets:

1. The set $\mathcal{D}$ which gathers all the possible *decisions*. Elements of $\mathcal{D}$ are atoms of $\mathcal{L}$.
2. The set $\mathcal{C}$ represents the *contextual information* which are formulas of $\mathcal{L}$. This base is assumed to be consistent. This corresponds to the factual situation about the current knowledge.
3. The set $\mathcal{K}$ represents the *background knowledge* made of a set of formulas such as $c \wedge d \rightarrow g$ with c is the conjunction of all formulas of $\mathcal{C}$, $d \in \mathcal{D}$ and g is a goal, with the intended meaning that in context c, decision d leads to satisfy g. This base is assumed to be consistent and contains all the available knowledge on the effects of decisions in different contexts. $\mathcal{K} \cup \mathcal{C}$ is also assumed to be consistent.
4. The set $\mathcal{G}^+$ which will gather the *positive goals* of an agent. A positive goal represents what an agent wants to achieve. This base also is assumed to be consistent. Note that a goal may be expressed in terms of a logical combination of constraints on criteria values, and does not necessarily refer to one criterion.
5. The set $\mathcal{G}^-$ which will gather the *negative goals* of an agent. A negative goal represents what an agent rejects. This base is assumed to be consistent. Note that if g is a negative goal, this does not necessarily mean that $\neg g$ is positive. For instance, in case of choosing medical drug, one may have as a positive goal the immediate availability of the drug, and as a negative goal its availability only after at least two days. As it can be guessed on this example, if g is a positive goal only g' such that $g' \vdash \neg g$ can be a negative goal, and conversely.

In [5] the authors argued that when an agent expresses its goals, it usually does that in a *bipolar* way. On the one hand, it expresses what it really wants, what it considers as really satisfactory. These are *positive goals.* They will represent the goals which will be pursued by the agent. On the other hand, it expresses what it definitely rejects, what it considers as unacceptable. These are *negative goals*. They represent the goals which will not be pursued by the agent. This distinction between positive and negative goals is supported by recent studies in cognitive psychology which have shown that these two types of goals are independent and processed separately in the mind [7].

Note that, a rule of the form $c \wedge d \to g$ with $g \in \mathcal{G}^+$ can have an alternative reading under the form "in context c, d is advisable since it ensures g, where g is a goal". Similarly, the rule $c \wedge d \to g$ with $g \in \mathcal{G}^-$ can be read as "in context c, d is inadvisable since it ensures g, which is a rejection".
In this bipolar setting, a decision problem is defined as follows:

Definition 1 (Decision problem) *A* decision problem $\mathcal{T}$ *is a tuple* $\langle\mathcal{D}, \mathcal{K}, \mathcal{C}, \mathcal{G}^+, \mathcal{G}^-\rangle$.

We suppose that goals in $\mathcal{G}^+$ and $\mathcal{G}^-$ may not have equal priority. Thus, each base is supposed to be equipped with a complete preorder $\geq$.

$a \geq b$ iff a is at least as important as b.

For encoding it, we use the set of integers $T = \{1,\ldots,n\}$ as a linearly ordered scale, where n stands for the highest level of importance and '0' corresponds to the complete lack of importance. This means that the base $\mathcal{G}^+$ (resp. $\mathcal{G}^-$) is partitioned and stratified into $\mathcal{G}^+_1, \ldots, \mathcal{G}^+_n$ ($\mathcal{G}^+_1 \cup \ldots \cup \mathcal{G}^+_n$) (respectively $\mathcal{G}^-_1 \cup \ldots \cup \mathcal{G}^-_n$) such that all goals in $\mathcal{G}^+_i$ have the same importance level and are more important than goals in $\mathcal{G}^+_j$ where j < i.
Note that this approach can be developed using different bipolar scales, for instance one may also consider the [0, 1] interval for the positive part, and the [-1, 0] for the negative one. This will come closer to the current practice in possibilistic logic [5].
Solving a decision problem amounts to defining a pre-ordering, usually a complete one, on a set $\mathcal{D}$ of possible choices (or decisions), on the basis of the different consequences of each decision. Argumentation can be used for defining such a pre-ordering. The basic idea is to construct arguments in favor of and against each decision, to evaluate such arguments, and finally to apply some principle for comparing pairs of decisions on the basis of the quality or strengths of their arguments. Thus, an argumentation-based decision process can be decomposed into the following steps:

1. Constructing arguments in *favor* of */against* each decision in $\mathcal{D}$.
2. Evaluating the strength of each argument.
3. Comparing decisions on the basis of their arguments.
4. Defining a pre-ordering on $\mathcal{D}$.

An argumentation-based decision framework is defined as follows:

Definition 2 (Argumentation framework) *Let* $\mathcal{T} = \langle\mathcal{D}, \mathcal{K}, \mathcal{C}, \mathcal{G}^+, \mathcal{G}^-\rangle$ *be a decision problem. An* argumentation-based decision framework *for* $\mathcal{T}$ *is a triple* $<\mathcal{A}, \succeq, \texttt{Princ}>$ *where:*

- $\mathcal{A}$ *is a set of arguments built from* $\mathcal{T}$.
- $\succeq$ *is a (partial or complete) pre-ordering on* $\mathcal{A}$.
- `Princ` *is a (partial or complete) pre-ordering on* $\mathcal{D}$.

`Princ` denotes a decision principle that will be used for comparing decisions on the basis of their supporting/attacking arguments in $\mathcal{A}$.
The *output* of the framework is a (complete or partial) pre-ordering $\trianglerighteq_{\texttt{Princ}}$ on $\mathcal{D}$. $d_1 \trianglerighteq_{\texttt{Princ}} d_2$ means that the decision d_1 is *at least as preferred as* the decision d_2 w.r.t. the *principle* `Princ`.
Let A, B be two arguments of $\mathcal{A}$. If $\succeq$ is a pre-order, then $A \succeq B$ means that A is at least as 'strong' as B.
$\succ$ and $\approx$ will denote respectively the strict ordering and the relation of equivalence

associated with the preference between arguments. Hence, $A \succ B$ means that A is strictly preferred to B. $A \approx B$ means that A is preferred to B and B is preferred to A.

Different definitions of $\succeq$ or different definitions of `Princ` may lead to different decision frameworks which may not return the same results.

3 New typology of arguments

Each decision may have arguments in its favor (called PROS), and arguments against it (called CONS). An argument in favor of a decision represents the good consequences of that decision. In a multiple criteria context, for instance, this will represent the criteria which are positively satisfied. On the contrary, an argument against a decision may highlight the criteria which are insufficiently satisfied.

Two kinds of arguments in favor of a decision can be distinguished. The basic idea is that a decision is supported in two cases: either it ensures the satisfaction of at least a positive goal, or it avoids at least a negative one. Similarly, two kinds of arguments against a decision exist. A decision is attacked in two cases: either it violates a positive goal, or it ensures the satisfaction of a negative one. Note that these four cases are not redundant just because of g being a positive goal is not equivalent to $\neg g$ being a negative one. Formally:

Definition 3 (Argument PRO) *Let $\mathcal{T} = \langle \mathcal{D}, \mathcal{K}, \mathcal{C}, \mathcal{G}^+, \mathcal{G}^- \rangle$ be a decision problem. An argument in favor a decision d is tuple $A = \langle S, d, g \rangle$ such that:*

1. *$d \in \mathcal{D}$*
2. *$S \subseteq \mathcal{K}$*
3. *$S \cup \mathcal{C} \cup \{d\}$ is consistent*
4.
   - *$S \cup \mathcal{C} \cup \{d\} \vdash g$ if $g \in \mathcal{G}^+$ (arguments of Type 1), or*
   - *$S \cup \mathcal{C} \cup \{d\} \vdash \neg g$ if $g \in \mathcal{G}^-$ (arguments of Type 2)*
5. *S is minimal for set inclusion among the subsets of $\mathcal{K}$ satisfying the above conditions.*

Let $Arg_{P_1}(d)$ be the set of all arguments of type 1 in favor of d, and $Arg_{P_2}(d)$ the set of all arguments of type 2 in favor of d.

The two forms of arguments against a decision are captured by the following definition.

Definition 4 (Argument CON) *Let $\mathcal{T} = \langle \mathcal{D}, \mathcal{K}, \mathcal{C}, \mathcal{G}^+, \mathcal{G}^- \rangle$ be a decision problem. An argument against a decision d is tuple $A = \langle S, d, g \rangle$ such that:*

1. *$d \in \mathcal{D}$*
2. *$S \subseteq \mathcal{K}$*
3. *$S \cup \mathcal{C} \cup \{d\}$ is consistent*
4.
   - *$S \cup \mathcal{C} \cup \{d\} \vdash g$ if $g \in \mathcal{G}^-$ (arguments of Type 1), or*
   - *$S \cup \mathcal{C} \cup \{d\} \vdash \neg g$ if $g \in \mathcal{G}^+$ (arguments of Type 2)*
5. *S is minimal for set inclusion among the subsets of $\mathcal{K}$ satisfying the above conditions.*

Let $Arg_{C_1}(d)$ be the set of all arguments of type 1 against d, and $Arg_{C_2}(d)$ the set of all arguments of type 2 against d.

As one can see, our bipolar setting provides a richer typology of arguments.

In [3], it has been argued that arguments may have forces of various strengths. These forces allow an agent to compare different arguments in order to select the 'best' ones, and consequently to select the best decisions.
The force of an argument depends on the importance of the goals satisfied or violated by the decision.

Definition 5 (Force of an argument) *Let $A = \langle S, d, g \rangle$ be an argument. The* force *of an argument A is $Force(A) = \alpha$ such that $\alpha = i$ such that $g \in \mathcal{G}_i^+$, or $g \in \mathcal{G}_i^-$.*

Note that this notion of force can be refined by taking into account the certainty degrees of formulas of the base $\mathcal{K}$. Here for simplicity reasons, all the pieces of knowledge in $\mathcal{K}$ are assumed to be fully certain.

The forces of arguments make it possible to compare pairs of arguments.

Definition 6 (Comparing arguments) *Let A, B be two arguments. A is preferred to B, denoted $A \succeq B$ iff $Force(A) \geq Force(B)$.*

Note that the above relation is a *complete preorder*.

4 Decision status

In the above section, we have shown that each decision may be supported by two types of arguments, and attacked by two other types of arguments. Let $d \in \mathcal{D}$. Four sets of arguments are associated to d:

- $Arg_{P_1}(d)$ = they capture the positive goals that are reached when applying d in context $\mathcal{C}$
- $Arg_{P_2}(d)$ = they capture the negative goals that are avoided when applying d in context $\mathcal{C}$
- $Arg_{C_1}(d)$ = they capture the negative goals that are not avoided when applying d in context $\mathcal{C}$
- $Arg_{C_2}(d)$ = they capture the positive goals that are missed when applying d in context $\mathcal{C}$

Note that when a given set is empty, for instance $Arg_{P_1}(d) = \emptyset$, this does not mean that decision d cannot lead at all to any goal, but rather because information is missing, we cannot be certain at all that a goal is reached. The above types of arguments supporting or attacking a decision d give birth to four main different *status* for that decision: *recommended*, *discommended*, *neutral* and *controversial* (see Table 1). Recommended decisions are those decisions that have only arguments in favor of them and no arguments against of any type. Discommended decisions are those decisions that have no arguments in favor of them and only arguments against them. Regarding neutral decisions, they have neither arguments in favor of them, nor arguments against. Decisions that have at the same time arguments in favor of them and arguments against are said controversial.

Note that arguments of type 2 allow the refinement of each status. For instance, a decision which has both types of arguments in favor of it will be said to be strongly recommended, whereas a decision with only arguments in favor of it of type 1 are only recommended.

Property 1 *Let $d \in \mathcal{D}$. d is either fully recommended, or fully discommended, or controversial or neutral.*

5 Comparing decisions

Comparing decisions is an important step in a decision process. Below we present some intuitive principles in our bipolar setting.

It is clear that recommended decisions are to be preferred to neutral decisions. Dually, discommended decisions are worst than neutral decisions. This defines what we call here a *basic ordering*.

Definition 7 (Basic ordering) *Let d, $d' \in \mathcal{D}$.*

- *If d is recommended and d' is neutral or discommended, then $d \rhd_{\texttt{Princ}} d'$.*
- *If d is neutral and d' is discommended, then $d \rhd_{\texttt{Princ}} d'$.*

Note that a recommended decision is not always to be preferred to a controversial one, nor a controversial decision is necessarily to be preferred to a discommended one, even if the global strengths of the arguments that support both decisions are equivalent in absolute value. This is still more obvious with arguments having different values. For instance, a controversial decision that satisfies three important goals in $\mathcal{G}_n^+$ and leads to the satisfaction of one rejection in $\mathcal{G}_1^-$ might be preferred to a recommended decision that has only one

Status	Sub-status	Combination
Recommended	Strongly recom.	$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
	Recom.	$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
	Weakly recom.	$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
Discommended	Strongly discom.	$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$
	Discom.	$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
	Weakly discom.	$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$
Neutral		$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
Controversial		$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$
		$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
		$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$
		$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$
		$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
		$\langle Arg_{P_1}(d) \neq \emptyset, Arg_{P_2}(d) = \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$
		$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$
		$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) \neq \emptyset, Arg_{C_2}(d) = \emptyset\rangle$
		$\langle Arg_{P_1}(d) = \emptyset, Arg_{P_2}(d) \neq \emptyset, Arg_{C_1}(d) = \emptyset, Arg_{C_2}(d) \neq \emptyset\rangle$

Table 1: Decision status

goal satisfied in $\mathcal{G}_n^+$. Still a recommended decision is always easier to explain and to advocate than a controversial one.

This basic ordering needs to be refined in order to be able to compare pairs of decisions having the same status, and also controversial decisions with decisions of any other status. For refining the ordering of recommended decisions, and of discommended, one has only to use unipolar criteria focusing only on one category of arguments, either arguments in favor of, or against a decision d respectively. A simple unipolar principle consists, for instance in the case of recommended decisions, in counting the arguments in favor of each decision. The idea is to prefer the decision which has more supporting arguments.

Definition 8 (Counting arguments pros) *Let d_1, $d_2 \in \mathcal{D}$ such that d_1, d_2 are both recommended. $d_1 \lhd_{CAP} d_2$ w.r.t CAP iff $|Arg_{P_1}(d_1)| > |Arg_{P_1}(d_2)|$, where $|B|$ denotes the cardinality of a given set B.*

In case of ties, this criterion can be further refined by taking into account the forces of the arguments. This amounts to lexicographical ordering of vectors associated to decisions, each vector listing decreasingly the strength of supporting arguments.

Controversial arguments can also be compared using a bipolar criterion such as the one which prefers a decision d over decision d' if d has a supporting argument which is stronger than any supporting argument for d', but there is no argument against d which is stronger than any argument against d'.

Definition 9 *Let d_1, $d_2 \in \mathcal{D}$. $d_1 \lhd d_2$ iff:*

- *$\exists$ $A \in Arg_{P_1}(d_1)$ such that $\forall$ $B \in Arg_{P_1}(d_2)$, $A \succ B$, and*
- *$\nexists$ A' $\in Arg_{C_1}(d_1)$ such that $\forall$ B' $\in Arg_{C_1}(d_2)$, $A \succeq B$.*

Note that even if this criterion is intuitively appealing, it only provides a partial ordering, and moreover, it does not take into account the number of arguments of a given strength.

One way to cope with this limitation consists in the lexicographical comparison of vectors associated with each decision, each vector is now made of two parts: the first one lists the strength of arguments against decreasingly, while the second lists the strengths of arguments in favor of d decreasingly.

Moreover, before comparing these vectors, it is possible to perform on them a cancellation of positive and negative components of equal strengths. This would correspond to a kind of trade-off suggested by Benjamin Franklin who first suggested that positive arguments counter-balance negative arguments of equal strength. Note that with such a principle a given decision may change its status in the sense of Table 1. Indeed, a controversial decision with two arguments in favor of it and one argument against (all of them having the same absolute strength) can then be viewed as equivalent to a recommended decision with one argument in favor of it.

6 Related works

As said in the introduction, some works have been done on arguing for decision. Quite early, in [10] Brewka and Gordon have outlined a logical approach to decision (for negotiation purposes), which suggests the use of defeasible consequence relation for handling prioritized rules, and which also exhibits arguments for and against each choice. However, arguments are not formally defined, and bipolarity of goals is not mentioned. The framework proposed in this paper could be extended to the cases where $\mathcal{K}$ contains defeasible rules.

In the framewotk proposed by Fox and Parsons in [8], no explicit distinction is made between knowledge and goals. However, in their examples, values (belonging to a linearly ordered scale) are assigned to formulas which represent goals. These values provide an empirical basis for comparing arguments using a symbolic combination of strengths of beliefs and goals values. This symbolic combination is performed through dictionaries corresponding to different kinds of scales that may be used. In this work, only type of arguments is considered in the style of arguments if favor of beliefs.

In [6], Bonet and Geffner have also proposed an original approach to qualitative decision, inspired from Tan and Pearl [11], based on "action rules" that link a situation and an action with the satisfaction of a *positive* or a *negative* goal. However in contrast with the previous work and the work presented in this paper, this approach does not refer to any model in argumentative inference.

More recently, in [4], Amgoud and Prade have proposed an argumentation-based framework for decision making under uncertainty. However, their approach has some limitations from a pure argumentation point of view. Indeed, in that approach, rejections are not considered, and thus there was only one type of arguments PRO and one type of arguments CONS. Moreover, these arguments are taking into account the goal base as a whole, and as a consequence, for a given decision there is at most a unique argument PRO and a unique argument CONS. This does not really fit with the way human are discussing decisions, for which there are usually several arguments PRO and CONS, rather than summarized ones. On the contrary in this paper, we have discussed several types of arguments PRO and CONS in a systematic way, and each argument pertains to only one goal or one rejection.

In [2], another argumentation-based model has been proposed for multiple criteria decision only.

In [1], a general setting for capturing both decision making and inference has been proposed. The proposed model intends to capture different kinds of decision problems. In that setting, bipolarity is not studied deeply as it is the case in the present paper. Moreover, rule-based decision is handled separately from the other types of decision problems. Indeed, a decision may have recommending arguments based on the fact that the decision is recommended by a rule, and decision arguments of the type considered here stating that a decision leads to the satisfaction of goals.

7 Conclusion

The proposed model aims at providing a simple but realistic approach to argumentation-based decision, taking advantage of bipolar evaluation structure for decision consequences, handling both multiple goals and incomplete information. This approach is qualitative in nature.

The argumentation-based procedure proposed here could be reused in argumentation-based negotiation dialogues where offers are discussed between agents on the basis of arguments pro and cons.

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