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Deontic Logic and Normative Systems

17th International Conference, DEON 2025

Editors
Kees van Berkel
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Extended Abstracts

Deontic Argumentation

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The primary motivation for our research is the limitations in existing argumentation semantics as applied to deontic logic, such as grounded and stable semantics, which inadequately handle weak permissions under conflicts (see [1]). These methods often prevent justifications for weak permission due to their inherent limitations in conflict resolution, notably when multiple deontic rules apply simultaneously. To address these limitations, we propose an argumentation semantics that effectively incorporates weak permission by allowing a more nuanced evaluation of arguments. Our approach ensures that both obligations and permissions are considered robustly within argumentative frameworks (for the full details see [2]).

The language of a deontic argumentation is built from a set of literals (Lit), where a literal is either an atom (l) or its negation ($\neg l$). In addition, we extend the language with *deontic literals*, where a deontic literal is a literal prefixed by a deontic operator (obl for oblitation, perm for permission and perm_w for weak permission). Given a literal l, we use $\sim l$ to denote the complement of l.

Arguments are built from rules, where a rule has the following format:

$$a_1, \dots a_n \Rightarrow c$$

Where $\{a_1, \dots, a_n\}$ is a (possibly empty) set of literals and deontic literals, and c is either a literal or deontic literal but not a weak permission (i.e., $c \neq \mathsf{perm}_w(l)$, otherwise it would be an explicit permission). A *Deontic Argumentation Theory* is a structure (F, R) where F is a (finite and possibly empty) set of literals (the fact or assumption of the theory), and R is a (finite) set of rules.

The two key notions of a deontic argumentation are the notion of *argument* and *attack*. For arguments, we have two types of arguments: *imaginary arguments* and *natural arguments*. The former are arguments that are not based on rules, but rather on the existence of a literal. Thus, for every literal $l \in \mathcal{L}$, we

have an imaginary argument $\mathsf{perm}_w(l)$, which is a weak permission argument for l. Natural arguments are built from rules in R (and facts). Every literal given as a fact is a natural argument, and every rule $a_1, \ldots, a_n \Rightarrow c$ in R gives rise to a natural argument $A = A_1, \ldots, A_n \Rightarrow c$, where each A_i is an argument such that the conclusion of the argument is a_i. Finally, to account for the deontic nature, for every argument A whose conclusion is a deontic literal $\mathsf{obl}(l)$ we create an argument $B = A \Rightarrow \mathsf{perm}(l)$.

Two (deontic) literals are in conflict if they are the negation of each other. Moreover, two deontic literals are in conflict if one is an obligation and the literals in the scope of the deontic operators are in conflict.

An argument A *attacks* an argument B iff A is a natural argument and the conclusion of a subargument of A is the complement of the conclusion of B.

A set of arguments S *supports* an argument A if every proper subargument of A is in S, and *undercuts* an argument B if S supports an argument A that attacks a proper subargument of B.

The next two notions we introduce are crucial for the semantics we propose, namely when an argument is accepted by a set of arguments we consider valid and rejected by the set of arguments we consider invalid.

Let R and S be two (disjoint) sets of arguments. An argument A is *wp-acceptable* by the sets of arguments R and S iff A is an imaginary argument and every argument attacking it is wp-rejected by R and S; or A is a natural argument, S supports A, and every argument attacking A is undercut by S.

An argument A is *wp-rejected* by the sets of arguments R and S iff A is an imaginary argument and it is attacked by an argument in S; or A is a natural argument and either one of its (proper) subarguments is wp-rejected by R or S, or there exists an argument supported by S that attacks A.

The semantics is based on the notion of an extension. The extension of a theory is the fixed point of the following construction. The *wp-extension* of a Deontic Argumentation Theory T is the pair

$$(JArgs, RArgs)$$

where $JArgs = \bigcup_{i=1}^{\infty} J_i^T$ and $RArgs = \bigcup_{i=1}^{\infty} R_i^T$, and the sequences of sets J_i^T and R_i^T start with the empty set and J_{n+1}^T and R_{n+1}^T are, respectively, the sets of arguments that are wp-acceptable and wp-rejected by the sets R_n^T and J_n^T.

It is possible to show that for any theory T, the wp-extension is well-defined in the sense that the sequences of sets J_i^T and R_i^T are monotonically increasing, hence the fixed point exists. The wp-extension is unique, conflict-free, and the sets of acceptable and rejected arguments are disjoint (e.g., $JArgs \cap RArgs = \emptyset$).

Finally, the wp-semantics is able to properly accommodate weak permissions in the presence of conflicting obligations. Thus, given a theory with two conflicting rules $\cdots \Rightarrow \mathsf{obl}(l)$ and $\cdots \Rightarrow \mathsf{obl}(\sim l)$, the wp-extension contains the arguments $\mathsf{perm}_w(l)$ and $\mathsf{perm}_w(\sim l)$.

References

[1] Governatori, G., *Weak permission is not well-founded, grounded and stable* (2024).
URL `https://arxiv.org/abs/2411.10624`
[2] Governatori, G. and A. Rotolo, *Deontic argumentation* (2025).
URL `https://arxiv.org/abs/2505.xxxx`