A Distributed Argumentation Framework using Defeasible Logic Programming

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Outline

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Overview

- DeLP (*Defeasible Logic Programming*) consists of facts, strict and defeasible rules

$Bird(tweety).$	(fact)
$Bird(X) \leftarrow Penguin(X).$	(strict rule)
$Flies(X) \prec Bird(X).$	(defeasible rule)

- A defeasible logic program (*de.l.p.*) $\mathcal{P}$ is a tuple $\mathcal{P} = (\Pi, \Delta)$ with a set Π of facts and strict rules and a set Δ of defeasible rules.

Arguments and counterarguments

Let $\mathcal{P} = (\Pi, \Delta)$ be a *de.l.p.*

Definition (Argument, subargument)

$\langle \mathcal{A}, h \rangle$ with $\mathcal{A} \subseteq \Delta$ is an *argument* iff

- $\mathcal{A} \cup \Pi \mathrel{|\!\sim} h$
- $\mathcal{A} \cup \Pi \mathrel{|\!\not\sim} \bot$
- $\mathcal{A}$ is minimal

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Definition (Counterargument)

$\langle \mathcal{A}_1, h_1 \rangle$ is a *counterargument* of $\langle \mathcal{A}_2, h_2 \rangle$ at a literal h iff

$$\exists \langle \mathcal{A}, h \rangle : \mathcal{A} \subseteq \mathcal{A}_2 : \Pi \cup \{h, h_1\} \mid\!\sim \bot \quad (h \text{ and } h_1 \textit{ disagree})$$

Acceptable argumentation lines

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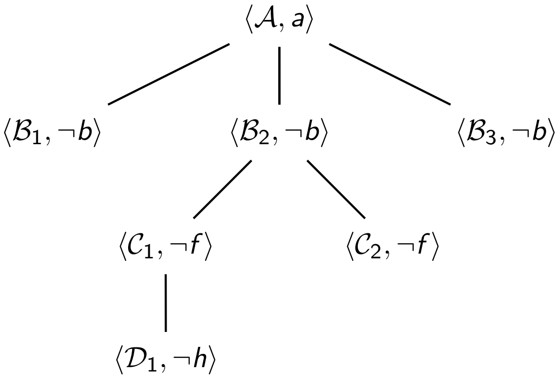
5. no argument $\langle \mathcal{A}_k, h_k \rangle$ is a subargument of a preceding argument.

The warrant procedure

Representation of the dialectical process in a *dialectical tree*:



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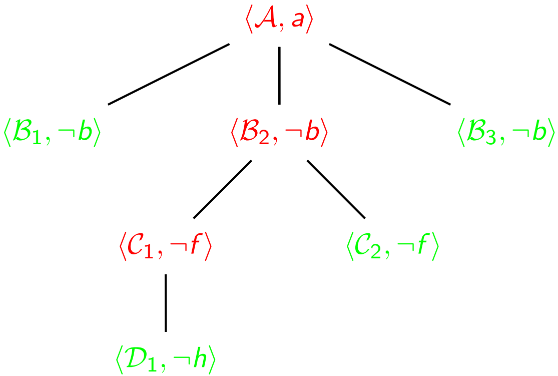

Warrant

Definition (Warrant)

A literal h is *warranted*, iff there exists an argument $\langle \mathcal{A}, h \rangle$ for h, such that the root of the marked dialectical tree $\mathcal{T}^*_{\langle \mathcal{A}, h \rangle}$ is marked "undefeated". Then $\langle \mathcal{A}, h \rangle$ is a *warrant* for h.

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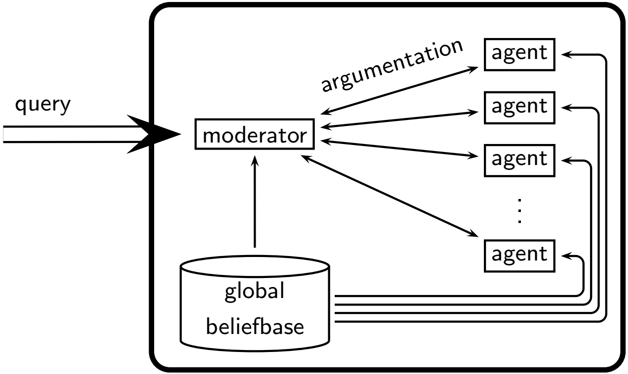
Overview 1/2


query
moderator
argumentation
agent
agent
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global
beliefbase

Overview 2/2

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Definition (Local belief base)

Let Δ be a set of defeasible rules and Π a global belief base. If $\Delta \cup \Pi$ is consistent (treating defeasible rules as strict rules), Δ is called *local beliefbase* relative to Π.

$\longrightarrow$ A local belief base reflects an agent's own beliefs besides the common beliefs.

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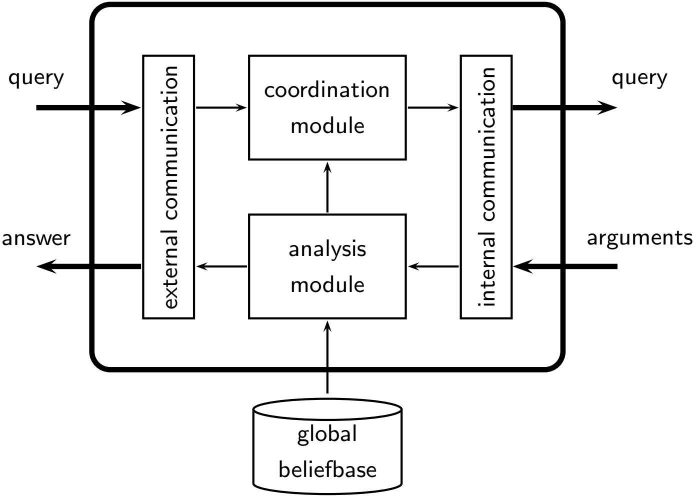

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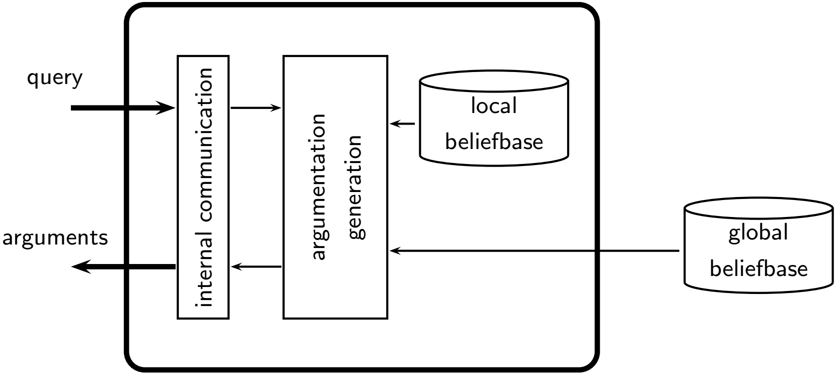
query
arguments
internal communication
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An *ArgMAS* is a tuple $(M, \Pi, \{A_1, \ldots, A_n\})$ with a moderator M, a global belief base Π and agents $A_1, \ldots, A_n$.

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Let h be a query (a literal) and T an ArgMAS. An *argumentation product* υ of T anf h is a dialectical tree with:

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2. For every path $\Lambda = [\langle \mathcal{A}_1, h_1 \rangle, \ldots, \langle \mathcal{A}_n, h_n \rangle]$ in υ it holds for the set K of all children of $\langle \mathcal{A}_n, h_n \rangle$

$$K = \{\langle \mathcal{B}, h' \rangle | \langle \mathcal{B}, h' \rangle \in \psi_1(\Lambda) \cup \cdots \cup \psi_n(\Lambda) \wedge \eta(\Lambda + \langle \mathcal{B}, h' \rangle) = 1\}.$$

An application scenario

- Assume two agents, acting as accuser and defender in a legal dispute.
- Then the moderator can be identified with the judge.
- A reasonable query for this multi agent system would be the question of guilt of the accused.
- As a first step to answer this query, the judge asks the accuser and the defender to propose initial arguments for and against the statement "The accused is guilty".
- Both, the defender and the accuser, can react to the arguments of their counterpart with counterarguments.
- Eventually, the judge analyses the resulting argumentation lines and returns "guilty" or "not guilty" to the questioner, i. e the people.

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Thank you for your attention