Argumentation among Agents: Review and Commentary

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Vasiliu Florin Vintilă Eduard

Introduction

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- Our contribution: several new examples, and proofs for some merely stated claims.
- What is the author attempting to formalize?
- The philosopher's view of argumentation: the giving of claims in favor or against a statement that is open for debate.

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- S, D are respectively the sets of strict/defeasible inference rules.

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- It is mandatory that

$$\neg\varphi \in cont(\varphi) \quad \text{and} \quad \varphi \in cont(\neg\varphi)$$

for any formula φ.

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- An *argument* from a knowledge base $\mathcal{K}$ is defined similarly to a deduction in propositional logic. (The members of $\mathcal{K}$ play the role of the hypotheses.)
- Major difference: incorporation of the used inference rules.
- The complete framework contains a partial order on defeasible rules. Using it, arguments may be compared.

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- Objective: define an "acceptable" argument.

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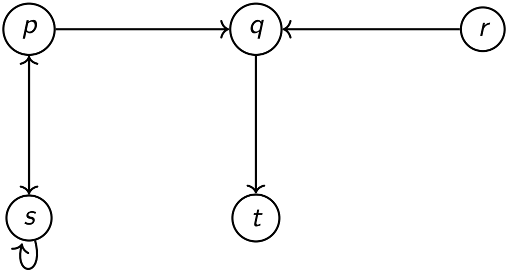

Figure: Our argumentation framework.

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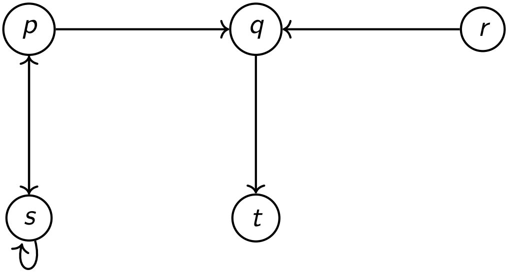

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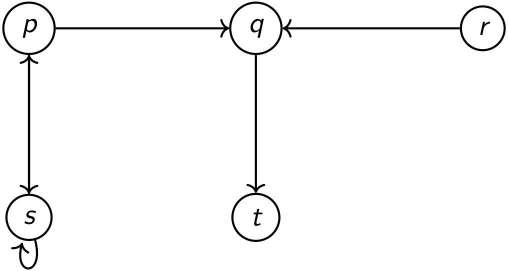

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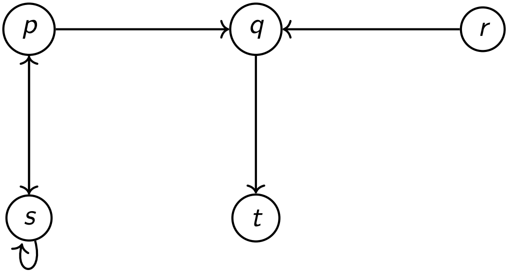

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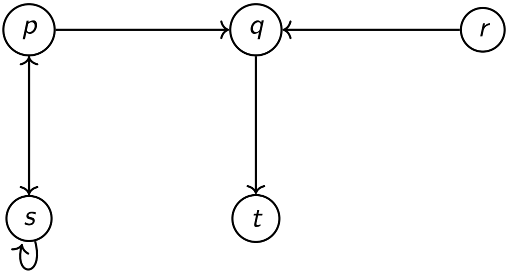

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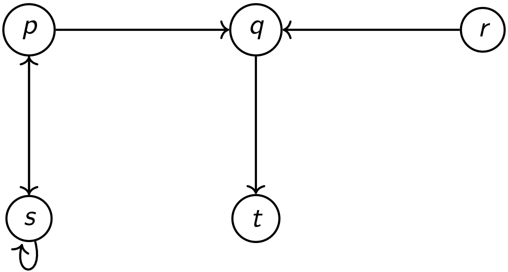

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- In the figure, $\{p, t\}$ and $\{r, t\}$ are conflict-free.

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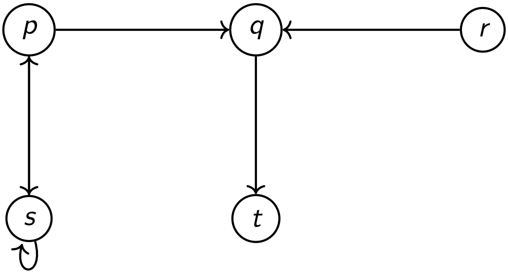

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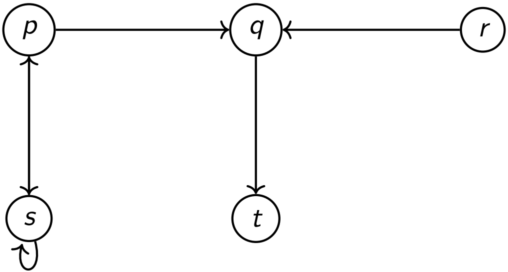

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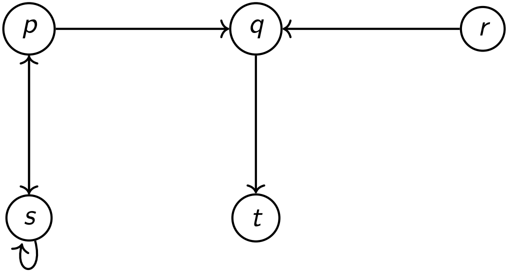

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  $\mathcal{F}(S) =$ the set of arguments defended by S.

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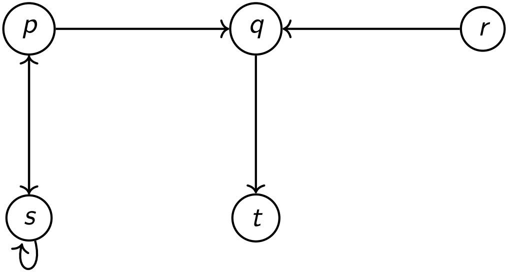

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- In the figure, $\mathcal{F}(\{p, q, r\}) = \{p, r, t\}$ and $\mathcal{F}(\{r, t\}) = \{r, t\}$.

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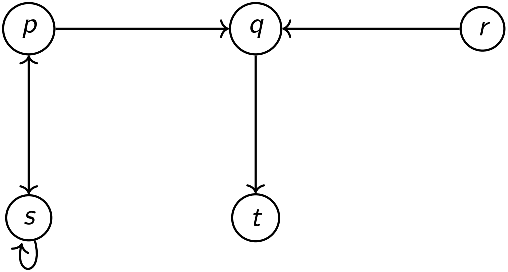

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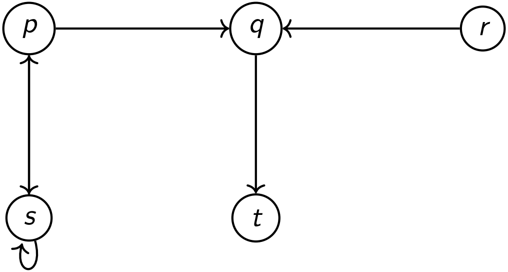

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- By the remarks on previous slides, $\{r, t\}$ is a complete extension.

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- An argument p is:
  - *skeptically accepted* iff p belongs to every extension;
  - *credulously accepted* iff p belongs to some extension;
  - *rejected* iff p doesn't belong to any extension.

Argumentation Games

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- Objective: Formalize such an argumentation process and additionally enforce a set of constraints in order to capture various semantics (for example, an agent cannot contradict himself).

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- Both players take turns in defeating the last argument that has been put forward by their counterpart player.
- The game is considered to be won by the player who states an argument a that cannot be defeated (i.e. $a^{-} = \emptyset$)

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Definition (dispute)

Given an argumentation framework $(\mathcal{A}, \rightharpoonup)$, a dispute is a nonempty, possibly infinite sequence d of arguments in $\mathcal{A}$ with the following property: $d_{i+1} \rightharpoonup d_i$, whenever i and $i+1$ are in d's domain (i.e. every argument in the sequence defeats its preceding argument).

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Definition (dispute trees)

Given an argumentation framework $(\mathcal{A}, \rightharpoonup)$ *and an argument* p *in* $\mathcal{A}$*, a dispute tree induced by* p *is a tree* T *rooted in* p*, where each node is labelled with an argument in* $\mathcal{A}$ *and for every node* v*,* v *has a child labelled* x *iff* v*'s label is defeated by* x*.*

An example from the book

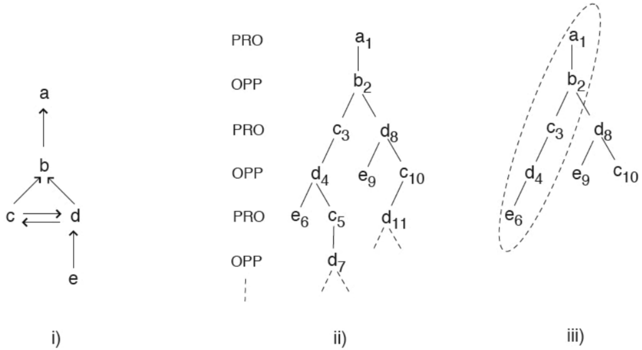

Figure 5.3: Argumentation framework and dispute tree. (i) shows an argumentation framework, (ii) shows the dispute tree induced in a, and (iii) shows the dispute tree induced by a under protocol G, with the winning strategy encircled.

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Claim

If T is a dispute tree under protocol G, then T is finite.

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- However, this contradicts protocol G. Hence, d is finite.

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  - facilitate argument manipulation and visual representation

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- Example: $MP_1 \in \mathcal{N}_S^{RA}$, an RA-node implementing the modus ponens *rule of inference scheme* from propositional logic.

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  - a binary relation $\xrightarrow{edge}: \mathcal{N} \times \mathcal{N}$, representing edges, with the restriction that $\forall i \in \mathcal{N}_I, \forall j \in \mathcal{N}_I, \nexists (i, j) \in \xrightarrow{edge}$

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  - $\tau \in \mathcal{N}_S^{RA}$ is an *RA-node*
  - $c \in \mathcal{N}_I$ is an I-node representing the conclusion, with the condition that $\tau \xrightarrow{edge} c$, uses$(\tau, s)$, $s \in \mathcal{S}$ and $\forall p \in P$ there is $p \xrightarrow{edge} \tau$

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Natural language arguments to AIF

- The argument:

(P_1) The sun's UV helps produce Vitamin D in your body

(P_2) Vitamin D is good for your health

Natural language arguments to AIF

- The argument:

(P_1) The sun's UV helps produce Vitamin D in your body
(P_2) Vitamin D is good for your health
(C_1) Therefore, the sun's UV is good for your health

Natural language arguments to AIF

- The argument:
  (P_1) The sun's UV helps produce Vitamin D in your body
  (P_2) Vitamin D is good for your health
  (C_1) Therefore, the sun's UV is good for your health
- We construct the tuple $A_1 = \langle \{P_1, P_2\}, HS_1, C_1 \rangle$, a simple argument in natural language, where $P_1, P_2 \in \mathcal{N}_I$ are premises and $C_1 \in \mathcal{N}_I$ is the conclusion. $HS_1 \in \mathcal{N}_S^{RA}$ is an RA-node, that uses the hypothetical syllogism scheme from propositional logic.

Natural language arguments to AIF

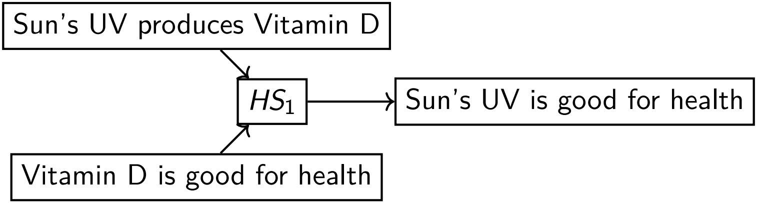

Figure: Argument network using natural language

Natural language arguments to AIF

- Coming up with a rebuttal:

Natural language arguments to AIF

- Coming up with a rebuttal:

(P_3) The sun's UV causes skin cancer

Natural language arguments to AIF

- Coming up with a rebuttal:

  (P_3) The sun's UV causes skin cancer

  (P_4) Skin cancer is bad for your health

Natural language arguments to AIF

- Coming up with a rebuttal:

(P_3) The sun's UV causes skin cancer
(P_4) Skin cancer is bad for your health
(C_2) Therefore, the sun's UV is bad for your health

Natural language arguments to AIF

- Coming up with a rebuttal:
  - (P_3) The sun's UV causes skin cancer
  - (P_4) Skin cancer is bad for your health
  - (C_2) Therefore, the sun's UV is bad for your health
- We use the previous simple argument $A_1 = \langle \{P_1, P_2\}, HS_1, C_1 \rangle$ and similarly define another simple argument $A_2 = \langle \{P_3, P_4\}, HS_2, C_2 \rangle$, where $P_3, P_4 \in \mathcal{N}_I$ are premises and $C_2 \in \mathcal{N}_I$ is the conclusion. $HS_2 \in \mathcal{N}_S^{RA}$ is an RA-node, that uses the hypothetical syllogism scheme from propositional logic. Conflict is displayed with CA-nodes NEG_1 and NEG_2, instantiations of a conflict scheme based on propositional contraries.

Natural language arguments to AIF

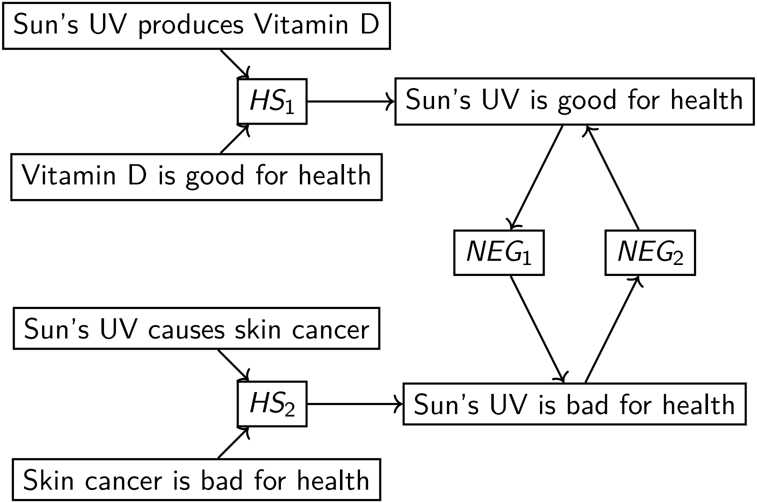

Figure: Argument network containing a rebuttal in natural language