Five weaknesses of ASPIC+

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Motivation

- Argumentation = an activity of reason aimed to increase (or decrease) the acceptability of a controversial standpoint by putting forward arguments

- Argumentation in AI = used for
  - reasoning about inconsistent premises
  - making decisions
  - modeling dialogues
  - ...

- ASPIC+ (Prakken 2010) = an argumentation system
  - It instantiates Dung's abstract framework

- Aim = { to show five serious flaws of ASPIC+ ; to study the properties of its underlying logics }

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Argumentation process

Monotonic logic $(\mathtt{L}, \mathtt{CN})$

$\downarrow$

Knowledge base $\mathcal{K} \subseteq \mathtt{L}$

$\downarrow$

Arguments $(\mathcal{A})$

$\downarrow$

Attacks between arguments $\mathcal{R} \subseteq \mathcal{A} \times \mathcal{A}$

$\downarrow$

Evaluation of arguments using a semantics

$\downarrow$

Plausible inferences from $\mathcal{K}$

ASPIC+: Logical language

- Abstract logical language $\mathcal{L}$ (for knowledge and names of rules)

- Strict / Defeasible rules: let $x_1, \ldots, x_n, x \in \mathcal{L}$
  - $x_1, \ldots, x_n \rightarrow x$ (if $x_1, \ldots, x_n$ hold then without exception x holds)
  - $x_1, \ldots, x_n \Rightarrow x$ (if $x_1, \ldots, x_n$ hold then presumably x holds)

  - They may represent either knowledge or reasoning patterns

- Contrariness function: $\bar{\ }: \mathcal{L} \longmapsto 2^{\mathcal{L}}$. Let $x \in \bar{y}$.
  - if $y \notin \bar{x}$, then x is a contrary of y
  - otherwise, x and y are contradictory

- Consistency: A set $X \subseteq \mathcal{L}$ is consistent iff $\nexists\, x, y \in X$ s.t. $x \in \bar{y}$. Otherwise, X is inconsistent.

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Some remarks on the logical formalism (1/2)

- No restrictions on $\mathcal{L}$ and rules. Thus,
  - $x \to (y \to z)$ is a strict rule
  - $(a \to b) \Rightarrow (x \to y)$ is a defeasible rule
- No distinction between knowledge and names of defeasible rules
  - $\neg f \in \mathcal{L}$ may be the name of $b \Rightarrow f$ (birds generally fly)

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- Let $\mathcal{L}$ be a propositional language
- Let $^{-}$ stand for classical negation
- $\mathcal{R}_s$ = the inference patterns of propositional logic, $\mathcal{R}_d = \emptyset$
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Knowledge bases

- Four bases: $\mathcal{K} = \mathcal{K}_n \cup \mathcal{K}_p \cup \mathcal{K}_a \cup \mathcal{K}_i$ s.t.
  - $\mathcal{K}_n$: a set of *axioms*
  - $\mathcal{K}_p$: *a set of ordinary premises*
  - $\mathcal{K}_a$: *a set of assumptions*
  - $\mathcal{K}_i$: *a set of issues*

- Remark: Strict and defeasible rules encode knowledge
  - "Penguins do not fly" is a strict rule ($p \to \neg f$) or an axiom?
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Arguments

- Arguments are trees

- Examples:
  - $\mathcal{L}$: a propositional language
  - $K_p = \{x, y\}$ and $\mathcal{K}_n = \mathcal{K}_a = \mathcal{K}_i = \emptyset$
  - $\mathcal{R}_s = \{x \to z\}$ and $\mathcal{R}_d = \{y, z \Rightarrow t\}$

  - $x, x \to z$ is an argument in favor of z
  - $x, x \to z, y, yz \Rightarrow t$ is an argument in favor of t

Conclusion

- *ASPIC+ may miss intuitive conclusions*

  Example:

  - *Let $\mathcal{L}$ be a propositional language and rules encode knowledge*
  - $\mathcal{K}_p = \{x \wedge y\}$ *and* $\mathcal{R}_s = \{x \to z\}$
  - *No argument in favor of z. Thus, z will not be inferred!!*

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Attacks 1/2

- Rebutting: to undermine the conclusion of an argument
  - $A : t, t \Rightarrow z, z \Rightarrow x, x \rightarrow y$ rebuts $B : t', t' \rightarrow z', z' \rightarrow x', x' \Rightarrow \neg y$
  - B does not rebut A
  - But, A is not more certain than B!

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ASPIC+ builds on counter-intuitive assumptions.

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Attacks 2/2

- Undermining: to undermine a premise of an argument
  - $x, x \to z$ undermines $\neg z, \neg z \to v$
- Undercutting: to undermine the applicability of a defeasible rule
  - Let $\mathcal{K}_n = \{b, \neg f\}$, $\mathcal{R}_d = \{b \Rightarrow f\}$ where $\neg f$ is the name of $b \Rightarrow f$

    A: b
    B: $b, b \Rightarrow f$
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  - B undercuts itself, B undermines C and C rebuts B
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- Dung's acceptability semantics (Dung, 1995)
  - E.g. Preferred semantics: maximal non-conflicting and self-defending sets of arguments

- Let $\mathcal{R}_d = \{\Rightarrow a, \Rightarrow b, \Rightarrow x, \Rightarrow z, a \Rightarrow (x \rightarrow y), b \Rightarrow (z \rightarrow \neg y)\}$, $\mathcal{R}_s = \mathcal{K}_n = \mathcal{K}_p = \mathcal{K}_a = \mathcal{K}_i = \emptyset$

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  - $\{A, B, C, D, E, F\}$ is the unique preferred extension
  - $a, b, x, z, x \rightarrow y, z \rightarrow \neg y$ are outputs of the system
  - The output is not closed (y is not inferred)
  - The output is indirectly inconsistent (y and $\neg y$)

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ASPIC+ violates the basic rationality postulates.

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ASPIC+ suffers from five main problems:

1. its logical formalism is ill-defined
2. it may return undesirable results
3. it builds on some counter-intuitive assumptions
4. it violates some rationality postulates
5. it allows counter-intuitive instantiations