FAKULTÄT FÜR INFORMATIK

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Investigating the Relationship between Argumentation Semantics via Signatures

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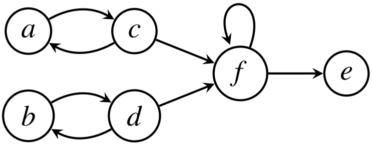
July 14, 2016

IJCAI-16

Introduction

- Argumentation in Artificial Intelligence
  - legal reasoning, online debates, medicine, ...
- Abstract Argumentation Framework (AF) [Dung, AIJ 1995]:



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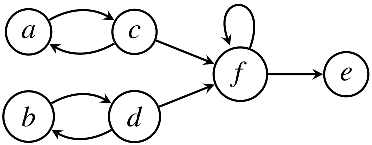

- Evaluation: argumentation semantics
- Extension: set of jointly acceptable arguments

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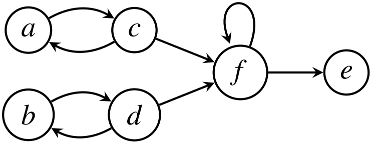

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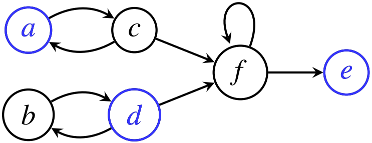

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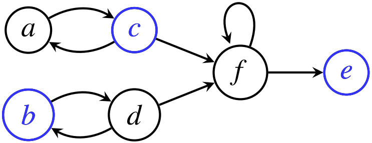

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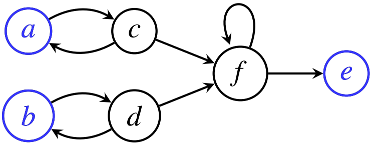

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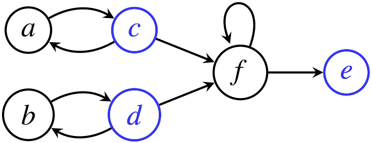

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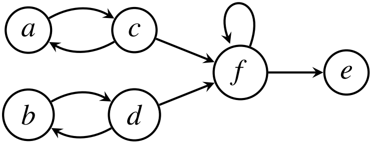

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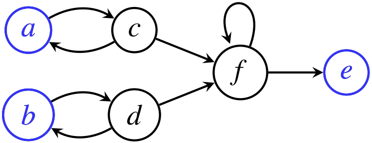

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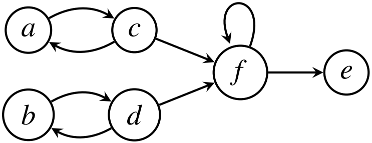

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- Further semantics: preferred, complete, grounded, semi-stable, ...

Introduction

- Systematic comparison of semantics [Baroni and Giacomin, AIJ 2007]
- Expressive power of semantics via realizability [Dunne et al., AIJ 2015].

Question

What sets of extensions can be the outcome of the evaluation of an arbitrary AF under semantics σ?

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- Systematic comparison of semantics [Baroni and Giacomin, AIJ 2007]
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Question

What sets of extensions can be the outcome of the evaluation of an arbitrary AF under semantics σ?

- Integral to AGM-style revision of AFs [Diller et al., IJCAI 2015]
  - Argumentation as inherently dynamic process
- Pruning of search space in solvers
  - Increasing interest in systems for solving reasoning tasks

Realizability & Signatures

Example

Given $\mathbb{S} = \{\{a, b\}, \{a, d, e\}, \{b, c, e\}, \{c, d, e\}\}$.

- $\exists F$ s.t. *prf*$(F) = \mathbb{S}$?

Realizability & Signatures

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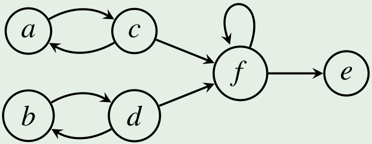

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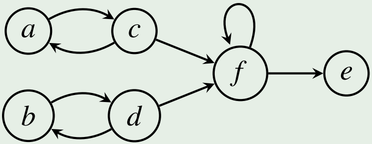

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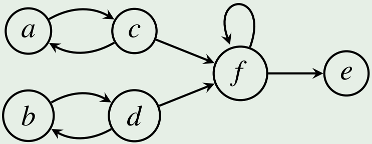

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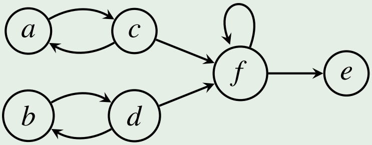

- $\exists F$ s.t. *stb*$(F) = \mathbb{S}$? No.
- $\exists F$ s.t. *nai*$(F) = \mathbb{S}$? No.

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Signature of semantics σ:

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Realizability & Signatures

Signature of semantics σ:

$$\Sigma_\sigma = \{\sigma(F) \mid F \text{ is an AF}\}$$

Theorem [Dunne et al., 2015]

$$\Sigma_{nai} = \{\mathbb{S} \neq \emptyset \mid \mathbb{S} = bd(\mathbb{S})\}$$
$$\Sigma_{stb} = \{\mathbb{S} \mid \mathbb{S} \subseteq bd(\mathbb{S})\}$$
$$\Sigma_{prf} = \{\mathbb{S} \neq \emptyset \mid \mathbb{S} \text{ incomparable and } \mathbb{S} \rtimes \mathbb{S}\}$$
$$\Sigma_{sem} = \{\mathbb{S} \neq \emptyset \mid \mathbb{S} \text{ incomparable and } \mathbb{S} \rtimes \mathbb{S}\}$$

Two-dimensional Signatures

Definition

Given semantics $\sigma_1, \ldots, \sigma_n$, their n-dimensional signature is defined as

$$\Sigma_{\sigma_1,\ldots,\sigma_n} = \{\langle \sigma_1(F), \ldots, \sigma_n(F) \rangle \mid F \text{ is an AF}\}.$$

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$\Rightarrow$ Well-known semantics relations:

- *stb* $\subseteq$ *sem* $\subseteq$ *prf* $\subseteq$ *com* $\subseteq$ *adm* $\subseteq$ *cf*,   *stb* $\subseteq$ *nai* $\subseteq$ *cf*

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- Other conditions?

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$\Rightarrow$ Measure of the independence of semantics.

$\Rightarrow$ Useful for the enumeration of multiple sets of extensions.

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$$\Sigma_{nai,stb} = \{\langle \mathbb{S}, \mathbb{T} \rangle \mid \mathbb{S} \in \Sigma_{nai}, \mathbb{T} \in \Sigma_{stb}, \mathbb{T} \subseteq \mathbb{S}\}$$

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$F_{\mathit{nai,stb}}(\mathbb{S}, \mathbb{T}) = (A, R)$ with

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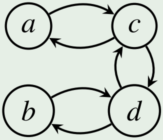

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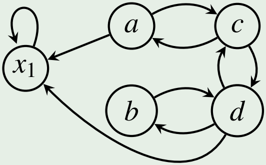

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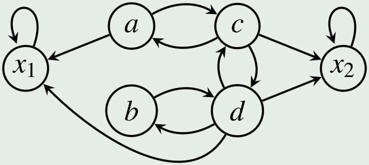

Two-dimensional Signatures

Example – Stable vs. Preferred

- $\mathbb{S} = \{\{a, b\}, \{a, d, e\}\}$
- $\mathbb{T} = \{\{a, b\}, \{a, d, e\}, \{b, c, e\}, \{c, d, e\}\}$
- $\langle \mathbb{S}, \mathbb{T} \rangle \in \Sigma_{stb,prf}$?

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- $\mathbb{S} \in \Sigma_{stb}$ ✔
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- $\mathbb{S} \subseteq \mathbb{T}$ ✔

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- $\mathbb{S} \in \Sigma_{stb}$ ✔
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- $\mathbb{S} \subseteq \mathbb{T}$ ✔
- However, $\langle \mathbb{S}, \mathbb{T} \rangle \notin \Sigma_{stb,prf}$ ✘

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Theorem

$$\Sigma_{\mathit{stb,prf}} = \{\langle \mathbb{S}, \mathbb{T} \rangle \mid \mathbb{S} \in \Sigma_{\mathit{stb}}, \mathbb{T} \in \Sigma_{\mathit{prf}}, \mathbb{S} \subseteq \mathbb{T} \cap \mathit{bd}(\mathbb{T})\}$$

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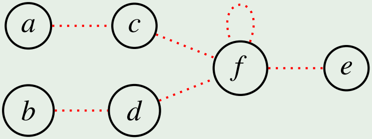

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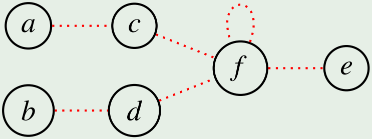

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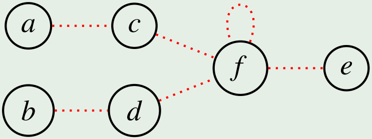

- $bd(\mathbb{T}) = \{\{a, b, e\}, \{a, d, e\}, \{b, c, e\}, \{c, d, e\}\}$

$\Rightarrow$ $\langle \mathbb{S}', \mathbb{T} \rangle \in \Sigma_{stb,prf}$ iff $\mathbb{S}' \subseteq \{\{a, d, e\}, \{b, c, e\}, \{c, d, e\}\}$.

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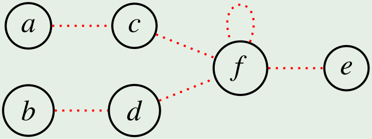

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Two-dimensional Signatures

	idl	*eag*	*nai*	*stb*	*sem*	*prf*	*cf*	*adm*
grd	✔	✔	✔	✔	✔	✔	✔	✔
idl	-	✔	✔	✔	✔	✔	✔	✔
eag		-	✔	✔	✔	?	✔	?
nai			-	✔	✔	✔	✔	✔
stb				-	✔	✔	✔	✔
sem					-	?	✔	?
prf						-	✔	✔
cf							-	✔

Two-dimensional Signatures

	idl	*eag*	*nai*	*stb*	*sem*	*prf*	*cf*	*adm*
grd	✔	✔	✔	✔	✔	✔	✔	✔
idl	-	✔	✔	✔	✔	✔	✔	✔
eag		-	✔	✔	✔	?	✔	?
nai			-	✔	✔	✔	✔	✔
stb				-	✔	✔	✔	✔
sem					-	?	✔	?
prf						-	✔	✔
cf							-	✔

- Concrete realizations of pairs of extension-sets.
- Exact characterizations: see poster.

Two-dimensional Signatures

	idl	*eag*	*nai*	*stb*	*sem*	*prf*	*cf*	*adm*
grd	✔	✔	✔	✔	✔	✔	✔	✔
idl	-	✔	✔	✔	✔	✔	✔	✔
eag		-	✔	✔	✔	?	✔	?
nai			-	✔	✔	✔	✔	✔
stb				-	✔	✔	✔	✔
sem					-	?	✔	?
prf						-	✔	✔
cf							-	✔

- Concrete realizations of pairs of extension-sets.
- Exact characterizations: see poster.

Conclusion

Summary:

- Exact characterizations of 32 of 36 two-dimensional signatures
- Constructions for standard realizations
- Discussion of the subtle issue of preferred and semi-stable semantics

Future work:

- Complete, stage semantics
- Labelling-based semantics
- Concrete pruning techniques
- n-dimensional signatures ($n > 2$)
- Other KR formalisms

References I

Baroni, P. and Giacomin, M. (2007).
On principle-based evaluation of extension-based argumentation semantics.
Artificial Intelligence, 171(10-15):675–700.

Diller, M., Haret, A., Linsbichler, T., Rümmele, S., and Woltran, S. (2015).
An Extension-Based Approach to Belief Revision in Abstract Argumentation.
In Yang, Q. and Wooldridge, M., editors, Proceedings of the 24th International Joint Conference on Artificial Intelligence (IJCAI 2015), pages 2926–2932. AAAI Press.

Dung, P. M. (1995).
On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming and n-person games.
Artificial Intelligence, 77(2):321–357.

Dunne, P. E., Dvořák, W., Linsbichler, T., and Woltran, S. (2015).
Characteristics of multiple viewpoints in abstract argumentation.
Artificial Intelligence, 228:153–178.