An overview of ranking-based argumentation semantics

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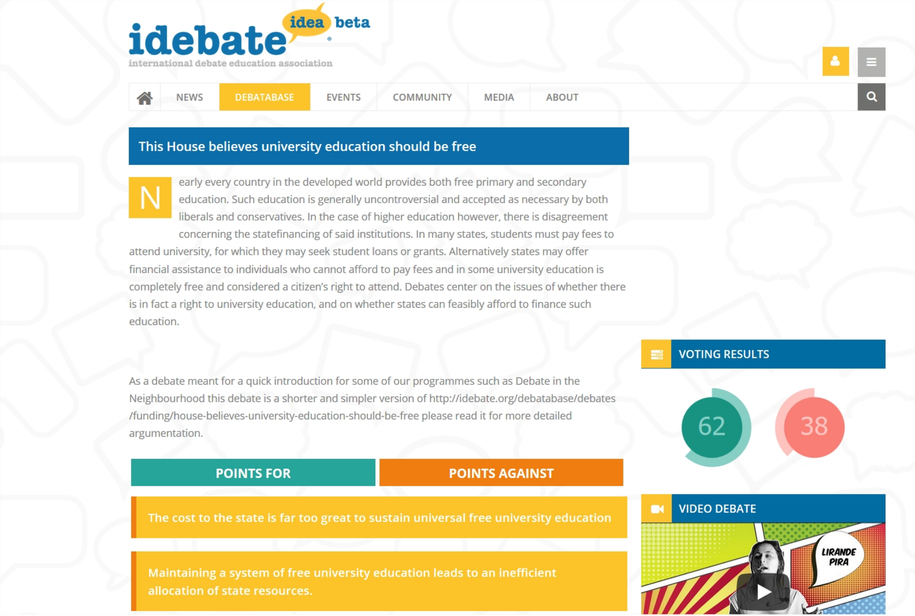
France

KR 2018 tutorial

Arguments are everywhere

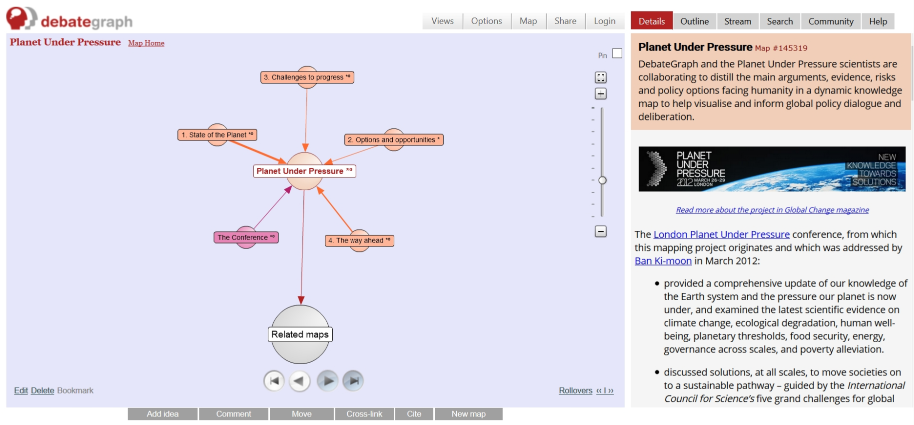
- Amazon
- YouTube
- idebate
- Debategraph
- Arguman
- ...

idebate

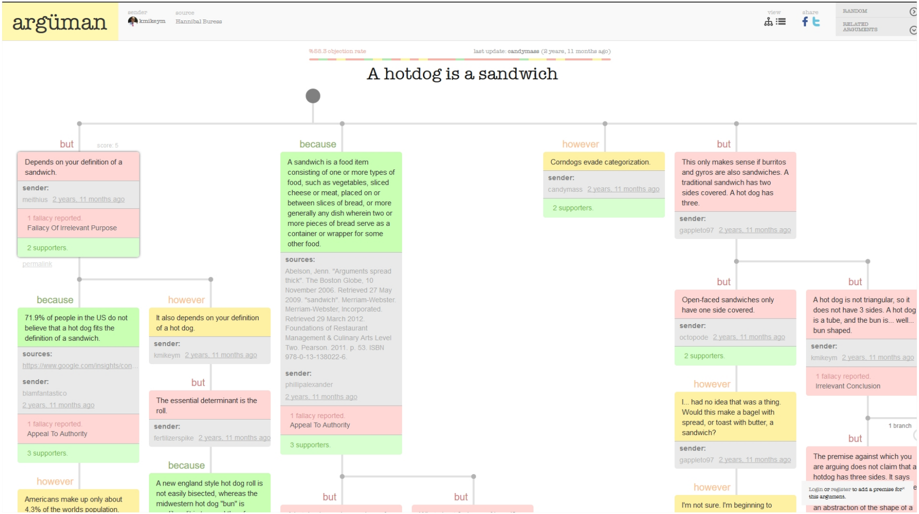


idebate
idea beta
international debate education association
NEWS
DEBATABASE
EVENTS
COMMUNITY
MEDIA
ABOUT
This House believes university education should be free
Nearly every country in the developed world provides both free primary and secondary education. Such education is generally uncontroversial and accepted as necessary by both liberals and conservatives. In the case of higher education however, there is disagreement concerning the statefinancing of said institutions. In many states, students must pay fees to attend university, for which they may seek student loans or grants. Alternatively states may offer financial assistance to individuals who cannot afford to pay fees and in some university education is completely free and considered a citizen's right to attend. Debates center on the issues of whether there is in fact a right to university education, and on whether states can feasibly afford to finance such education.
As a debate meant for a quick introduction for some of our programmes such as Debate in the Neighbourhood this debate is a shorter and simpler version of http://idebate.org/debatabase/debates /funding/house-believes-university-education-should-be-free please read it for more detailed argumentation.
VOTING RESULTS
62
38
POINTS FOR
POINTS AGAINST
The cost to the state is far too great to sustain universal free university education
Maintaining a system of free university education leads to an inefficient allocation of state resources.
VIDEO DEBATE
LIRANDE PIRA

DebateGraph



Arguman


argüman
sender
kmikeym
source
Hannibal Buress
view
share
RANDOM
RELATED ARGUMENTS
last update: candymass (2 years, 11 months ago)
A hotdog is a sandwich
but
score: 5
Depends on your definition of a sandwich.
sender:
meithius 2 years, 11 months ago
1 fallacy reported.
Fallacy Of Irrelevant Purpose
2 supporters.
permalink
because
A sandwich is a food item consisting of one or more types of food, such as vegetables, sliced cheese or meat, placed on or between slices of bread, or more generally any dish wherein two or more pieces of bread serve as a container or wrapper for some other food.
sources:
Abelson, Jenn. "Arguments spread thick". The Boston Globe, 10 November 2006. Retrieved 27 May 2009. "sandwich". Merriam-Webster. Merriam-Webster, Incorporated. Retrieved 29 March 2012. Foundations of Restaurant Management & Culinary Arts Level Two. Pearson. 2011. p. 53. ISBN 978-0-13-138022-6.
sender:
phillipalexander
2 years, 11 months ago
1 fallacy reported.
Appeal To Authority
3 supporters.
however
Corndogs evade categorization.
sender:
candymass 2 years, 11 months ago
2 supporters.
but
This only makes sense if burritos and gyros are also sandwiches. A traditional sandwich has two sides covered. A hot dog has three.
sender:
gappleto97 2 years, 11 months ago
because
71.9% of people in the US do not believe that a hot dog fits the definition of a sandwich.
sources:
https://www.google.com/insights/con...
sender:
blamfantastico
2 years, 11 months ago
1 fallacy reported.
Appeal To Authority
3 supporters.
however
Americans make up only about 4.3% of the worlds population.
however
It also depends on your definition of a hot dog.
sender:
kmikeym 2 years, 11 months ago
but
The essential determinant is the roll.
sender:
fertilizerspike 2 years, 11 months ago
because
A new england style hot dog roll is not easily bisected, whereas the midwestern hot dog "bun" is
but
but
but
Open-faced sandwiches only have one side covered.
sender:
octopode 2 years, 11 months ago
2 supporters.
however
I... had no idea that was a thing. Would this make a bagel with spread, or toast with butter, a sandwich?
sender:
gappleto97 2 years, 11 months ago
however
I'm not sure. I'm beginning to
but
A hot dog is not triangular, so it does not have 3 sides. A hot dog is a tube, and the bun is... well... bun shaped.
sender:
kmikeym 2 years, 11 months ago
1 fallacy reported.
Irrelevant Conclusion
1 branch
but
The premise against which you are arguing does not claim that a hotdog has three sides. It says
Login or register to add a premise for this argument.
an abstraction of the shape of a

Computational model of argument

Argumentation: an activity of reason aimed at increasing or decreasing the acceptability of a controversial standpoint by putting forward arguments

Exemple : A dialogue between two journalists

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J1 We must publish this information,
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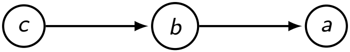
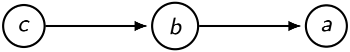
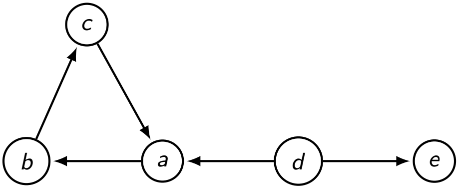


Computational model of argument

- An argumentation graph is a pair $\mathcal{F} = (\mathcal{A}, \mathcal{R})$ where:
  - $\mathcal{A}$ is a finite set of arguments
  - $\mathcal{R}$ is an attack relation ($\mathcal{R} \subseteq \mathcal{A} \times \mathcal{A}$)

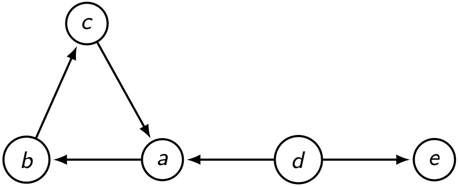


Which arguments to accept?



Which arguments to accept?

- A set S is conflict-free if there are no $a, b \in S$ such that $(a, b) \in R$



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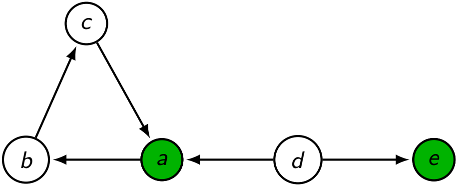

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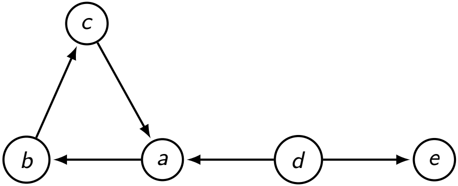

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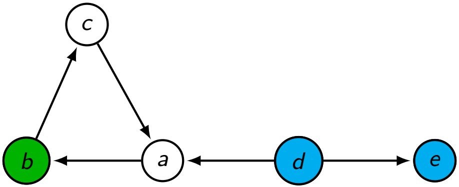

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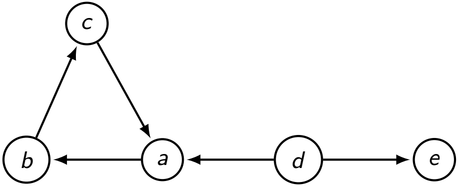
- A set of arguments is admissible if it is conflict-free and each argument of the set is defended by that set



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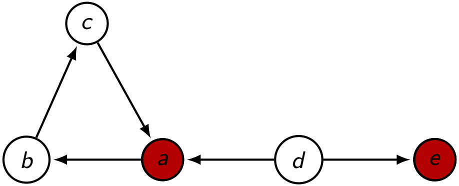

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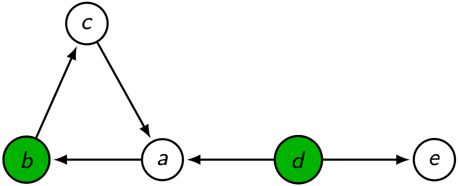

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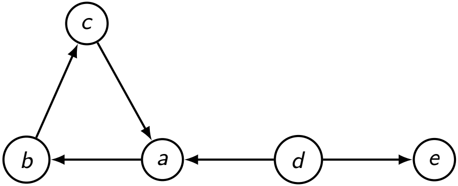

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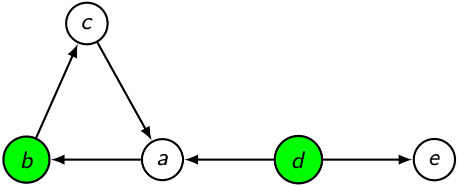

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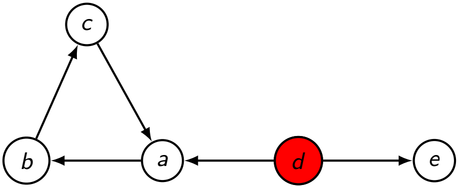

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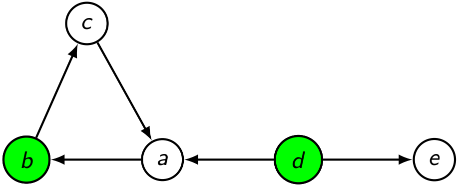

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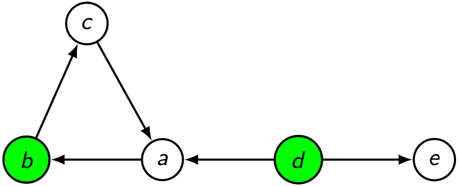

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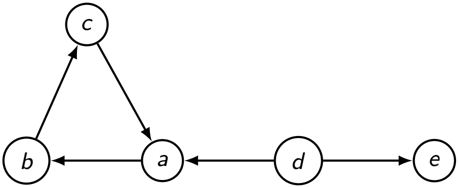

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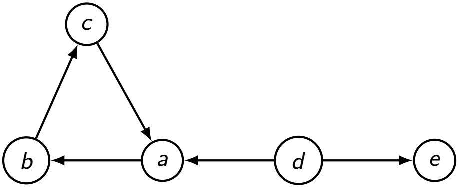

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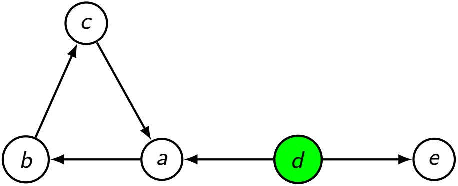

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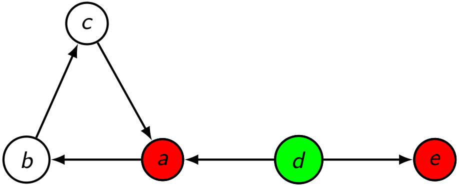

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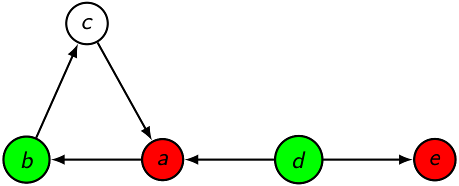

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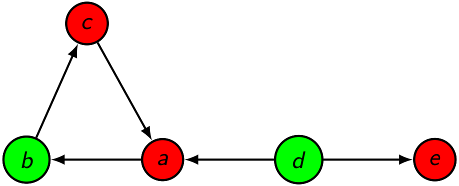

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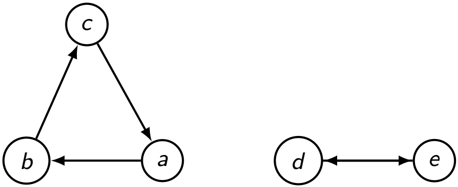

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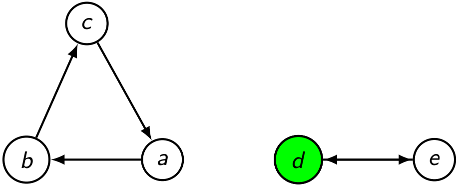

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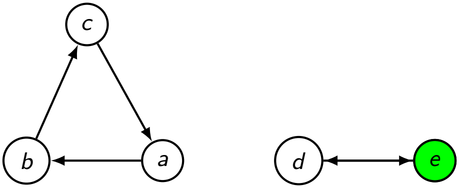
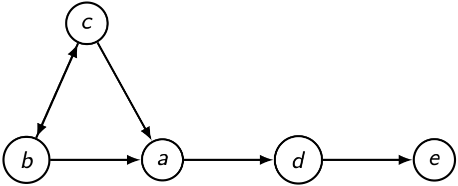


Exercise



Calculate stable, preferred, complete and grounded extensions

Advanced exercise

Provide a proof or find a counter example:

- Every stable extension is a preferred extension

Advanced exercise

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- Every stable extension is a preferred extension
- Every preferred extension is a complete extension
- Find a preferred extension that is not stable

Advanced exercise

Provide a proof or find a counter example:

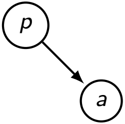
- Every stable extension is a preferred extension
- Every preferred extension is a complete extension

- Find a preferred extension that is not stable
- Find an argumentation graph that has at least one stable extension and that has a preferred extension that is not stable

A plethora of semantics

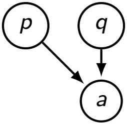
- Grounded
- Complete
- Stable
- Preferred
- CF2
- Semi-stable
- Ideal
- Stage
- Stage2
- Eager
- Grounded prudent
- Complete prudent
- Stable prudent
- Preferred prudent

Ranking-based semantics



- One successful attack has the same effect as several attacks

Ranking-based semantics



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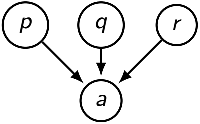

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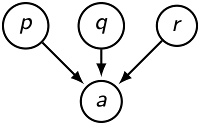

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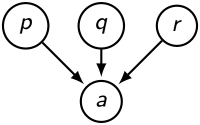
Ranking-based semantics



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Ranking-based semantics

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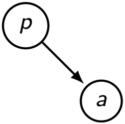
- Example: dialogues
  - a : *She is the best candidate for the posistion*

Ranking-based semantics



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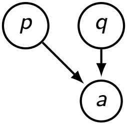
  - a : *She is the best candidate for the posistion*
  - p : *She does not have enough teaching experience*

Ranking-based semantics



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  - a : *She is the best candidate for the posistion*
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  - q : *She never published in this area*

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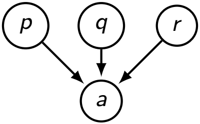

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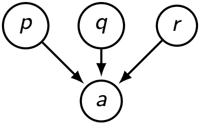

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  - p : *She does not have enough teaching experience*
  - q : *She never published in this area*
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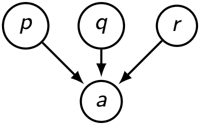
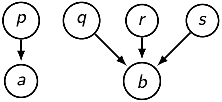
- In many situations:
  - One attack does not have the same effect as several attacks
  - One attack does not completely destroy its target

Ranking-based semantics



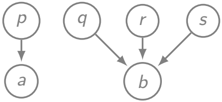
- One successful attack has the same effect as several attacks
- In some applications, this makes sense... but not always!
- Example: dialogues
  - a : *She is the best candidate for the posistion*
  - p : *She does not have enough teaching experience*
  - q : *She never published in this area*
  - r : *She does not speak English*
- In many situations:
  - One attack does not have the same effect as several attacks
  - One attack does not completely destroy its target
- Ranking-based semantics
  - do not compute extensions
  - assign a unique score to each argument

Some examples



$\mathcal{F}_1$

Some examples



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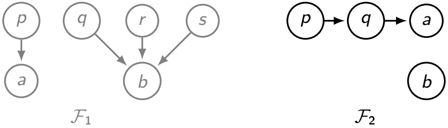

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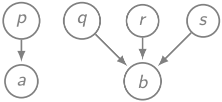

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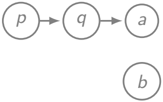
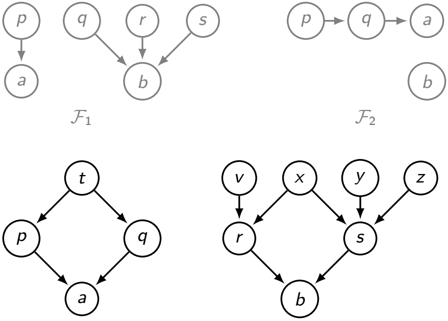


$\mathcal{F}_2$

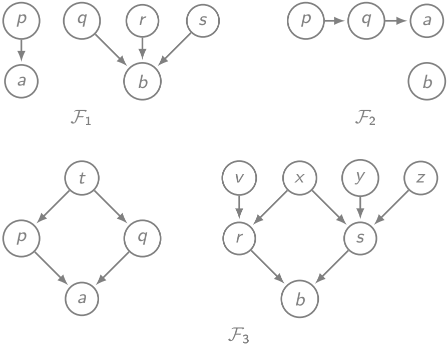
Some examples



$\mathcal{F}_1$ $\mathcal{F}_2$

$\mathcal{F}_3$

Some examples



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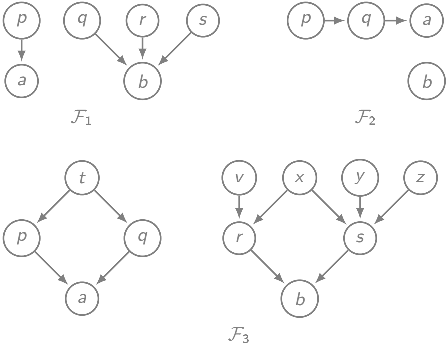

- An example of a ranking-based function: h-categorizer (Besnard & Hunter)

$$\texttt{Deg}(a) = \frac{1}{1 + \sum_{b \in \texttt{Att}(a)} \texttt{Deg}(b)}, \text{ with } \texttt{Deg}(a) = 1 \text{ if } \texttt{Att}(a) = \emptyset$$

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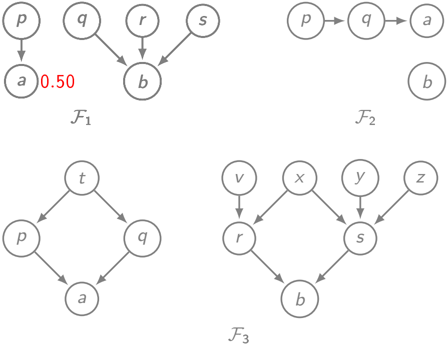

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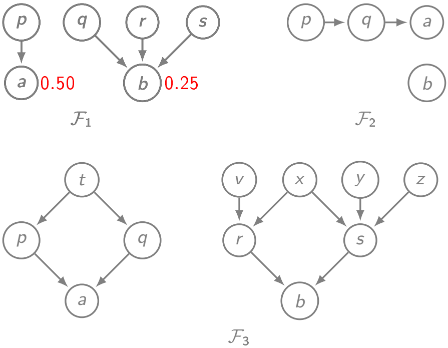

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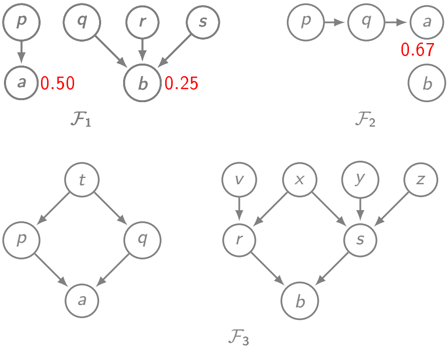

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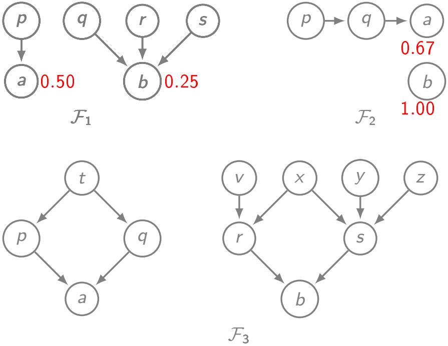

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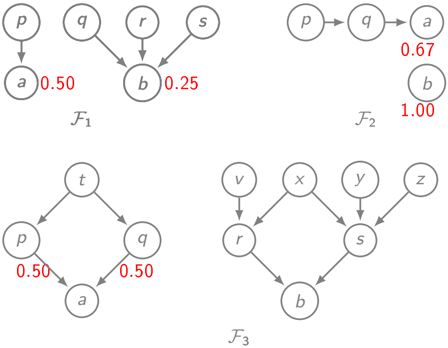

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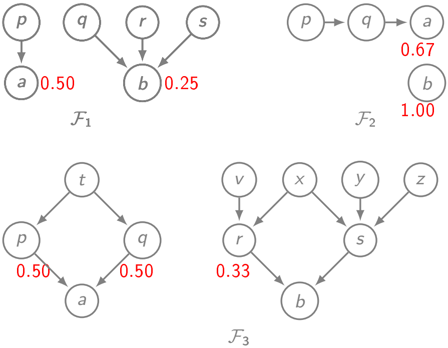

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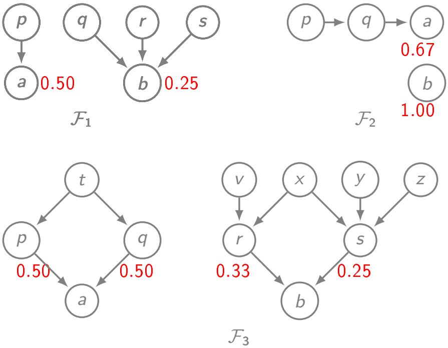

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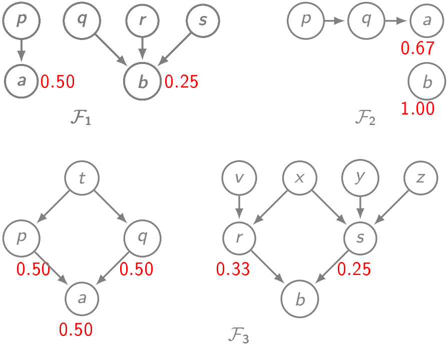

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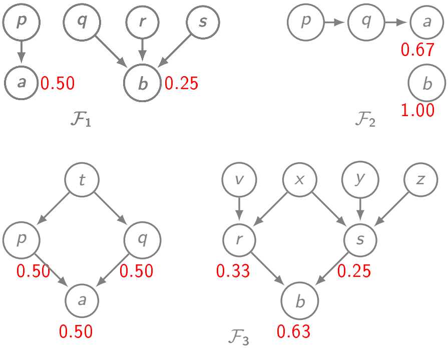

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Why principles?

Why do we study principles?

- better understanding of semantics
- definition of reasonable semantics
- comparing semantics
- choosing suitable semantics for applications

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Principles for weighted argumentation systems (Amgoud et al. IJCAI'17)

- arguments
- attacks
- intrinsic weights of arguments

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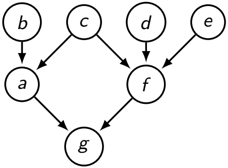
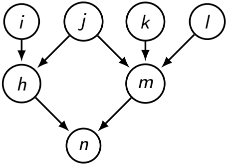
Principles for weighted argumentation systems (Amgoud et al. IJCAI'17)

- arguments
- attacks
- intrinsic weights of arguments
- An argument may be stronger than another one
  - made from more certain information
  - coming from a more reliable source
  - refers to a more important value

Anonymity

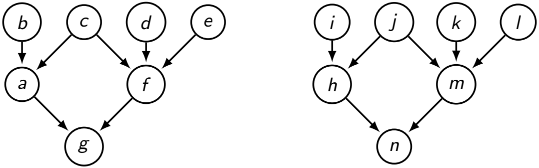


$\mathcal{F}_1$



$\mathcal{F}_2$

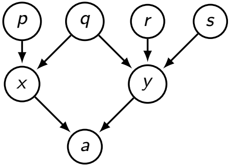
Anonymity



$\mathcal{F}_1$ $\mathcal{F}_2$

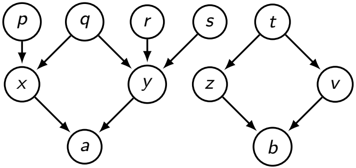
$$\mathtt{Deg}(g) = \mathtt{Deg}(n)$$
$$\mathtt{Deg}(a) = \mathtt{Deg}(h)$$
$$\vdots$$

Independence



$\texttt{Deg}(a)$, $\texttt{Deg}(x)$, $\texttt{Deg}(y)$, ... stay the same

Independence



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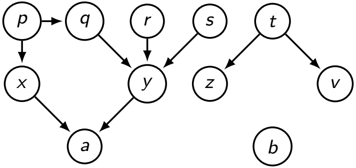
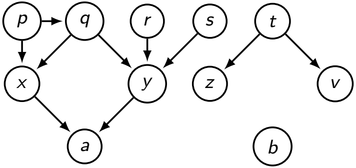
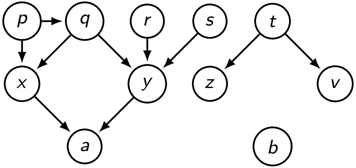
Directionality



Directionality

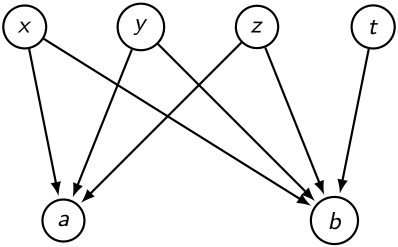


Directionality



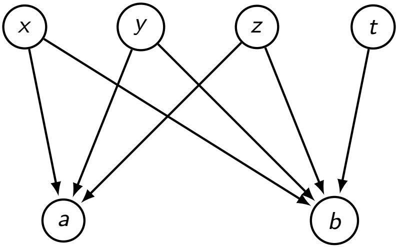
no path from x to c $\Rightarrow$ $\mathtt{Deg}(c)$ does not change

Neutrality



$$w(a) = w(b)$$
$$\mathtt{Deg}(t) = 0$$

Neutrality



$$\frac{w(a) = w(b) \quad \mathtt{Deg}(t) = 0}{\mathtt{Deg}(a) = \mathtt{Deg}(b)}$$

Equivalence

$$w(a) = w(b)$$
$$\exists \text{ a bijection } f : \texttt{Att}(a) \rightarrow \texttt{Att}(b) \text{ s.t. } \forall x \in \texttt{Att}(a), \texttt{Deg}(x) = \texttt{Deg}(f(x))$$

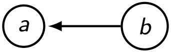
Equivalence

$$\frac{\begin{array}{c} w(a) = w(b) \\ \exists \text{ a bijection } f : \texttt{Att}(a) \rightarrow \texttt{Att}(b) \text{ s.t. } \forall x \in \texttt{Att}(a), \texttt{Deg}(x) = \texttt{Deg}(f(x)) \end{array}}{\texttt{Deg}(a) = \texttt{Deg}(b)}$$

Maximality

$$\frac{\mathtt{Att}(a) = \emptyset}{\mathtt{Deg}(a) = w(a)}$$

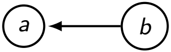
Weakening



$$w(a) > 0$$

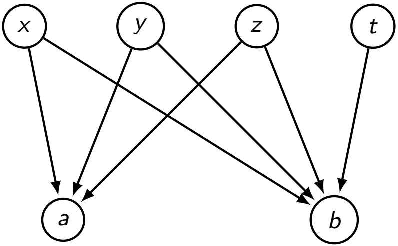
there exists $b \in \texttt{Att}(a)$ such that $\texttt{Deg}(b) > 0$

Weakening



$$\frac{w(a) > 0 \quad \text{there exists } b \in \texttt{Att}(a) \text{ such that } \texttt{Deg}(b) > 0}{\texttt{Deg}(a) < w(a)}$$

Counting



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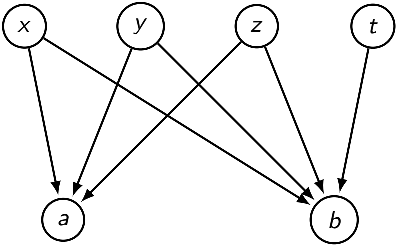
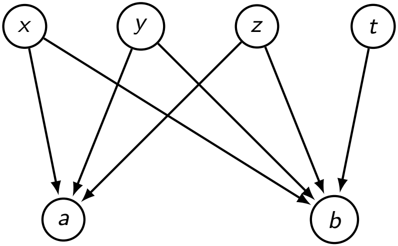


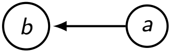
$$\texttt{Deg}(a) > 0$$
$$\texttt{Deg}(t) > 0$$
$$w(a) = w(b)$$

Counting



$$\frac{\mathtt{Deg}(a) > 0 \quad \mathtt{Deg}(t) > 0 \quad w(a) = w(b)}{\mathtt{Deg}(a) > \mathtt{Deg}(b)}$$

Weakening soundness



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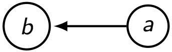

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a is attacked by at least one argument c such that $\texttt{Deg}(c) > 0$

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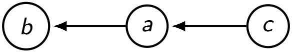

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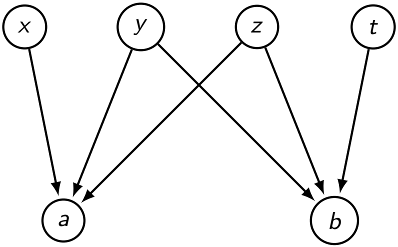
Reinforcement



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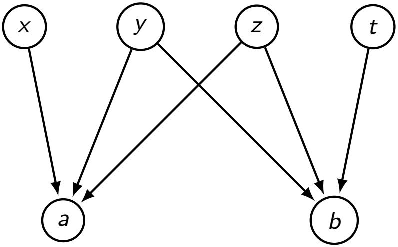

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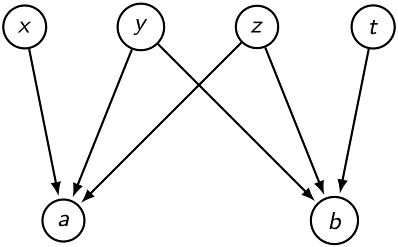

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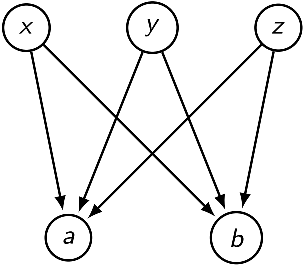
Resilience

$$\frac{w(a) > 0}{\texttt{Deg}(a) > 0}$$

Proportionality



$$\mathtt{Att}(a) = \mathtt{Att}(b)$$
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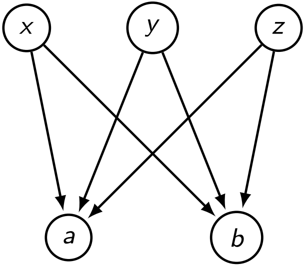

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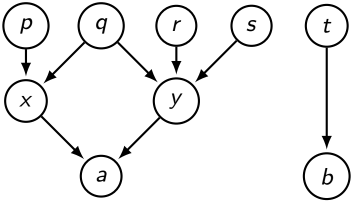
Quality precedence / Quantity precedence / Compensation



Some results

Theorem

Let a semantics **S** *satisfy Directionality, Independence, Maximality and Neutrality*

- *Then,* **S** *satisfies Weakening soundness*
- *If* **S** *satisfies Reinforcement, then it satisfies both Counting and Weakening*

Proof of the first item

Suppose **S** satisfies Directionality, Independence, Maximality and Neutrality and let us prove that it satisfies Weakening Soundness.

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Step. Let the inductive hypothesis hold for all $k < n$ and suppose that $|\mathtt{Att}_{\mathbf{G}}(a)| = n$ and that all the attackers of a have degree 0. Let x be an arbitrary attacker of a. Denote $S = \mathtt{Att}_{\mathbf{G}}(a) \setminus \{x\}$. Let $\mathbf{G}' = \langle \mathcal{A}', w', \mathcal{R}' \rangle$ be such that $\mathcal{A}' = \mathcal{A} \cup \{y\}$ where $y \notin \mathcal{A}$, $w'(t) = w(t)$ for all $t \in \mathcal{A}$, $w'(y) = w(a)$, $\mathcal{R} = \mathcal{R}'$.

Proof of the first item

Suppose **S** satisfies Directionality, Independence, Maximality and Neutrality and let us prove that it satisfies Weakening Soundness.

Let $\mathbf{G} = \langle \mathcal{A}, w, \mathcal{R} \rangle$ and $a \in \mathcal{A}$. We prove by induction on $|\mathtt{Att}(a)|$ that:
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By independence, the degrees of arguments are same in $\mathbf{G}$ as in $\mathbf{G}'$.

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Some results

Theorem

If a semantics $\mathbf{S}$ *satisfies Independence, Directionality, Neutrality, Proportionality, Weakening and Maximality, then for any WAG* $\mathbf{G} = \langle \mathcal{A}, w, \mathcal{R} \rangle$, *for any argument* $a \in \mathcal{A}$, *it holds that* $\mathtt{Deg}^{\mathbf{S}}_{\mathbf{G}}(a) \in [0, w(a)]$.

Some results

- Counter-transitivity of Amgoud and Ben-Naim (SUM'13) follows from some of the postulates
- If the attackers of an argument b are at least as numerous and strong as those of an argument a, then a is at least as strong as b

Some results

- Counter-transitivity of Amgoud and Ben-Naim (SUM'13) follows from some of the postulates
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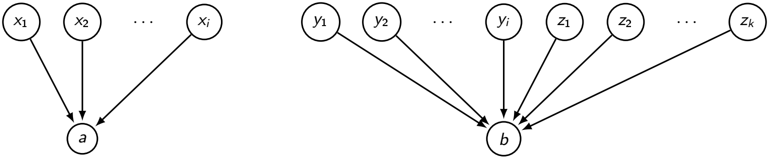
Theorem

If a semantics $\mathbf{S}$ *satisfies Independence, Directionality, Equivalence, Reinforcement, Maximality, and Neutrality, then for any WAG* $\mathbf{G} = \langle \mathcal{A}, w, \mathcal{R} \rangle$, $\forall a, b \in \mathcal{A}$, *if* $w(a) = w(b)$, *and there exists an injective function* f *from* $\mathtt{Att}_{\mathbf{G}}(a)$ *to* $\mathtt{Att}_{\mathbf{G}}(b)$ *such that* $\forall x \in \mathtt{Att}_{\mathbf{G}}(a)$, $\mathtt{Deg}^{\mathbf{S}}_{\mathbf{G}}(x) \leq \mathtt{Deg}^{\mathbf{S}}_{\mathbf{G}}(f(x))$, *then* $\mathtt{Deg}^{\mathbf{S}}_{\mathbf{G}}(a) \geq \mathtt{Deg}^{\mathbf{S}}_{\mathbf{G}}(b)$.

Counter-Transitivity



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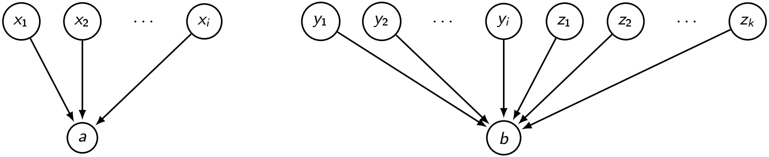

y_1 is more acceptable than x_1
y_2 is more acceptable than x_2
$\vdots$
y_i is more acceptable than x_i

---

a is more acceptable than b

A unifying perspective for principles

Baroni et al. (AAAI'18)

- Among existing principles, identify related ones
- Provide a unifying perspective for principles
- Define the principles which are implied by the parametric properties
  - balance
  - monotonicity

Weighted *h*-categorizer

- This semantics extends *h*-categorizer (Besnard & Hunter, AIJ 2001)
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Weighted h-categorizer

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Definition ($\mathtt{f_h}$)

Let $\mathbf{G} = \langle \mathcal{A}, w, \mathcal{R} \rangle$ be a WAG. For every argument $a \in \mathcal{A}$, for $i \in \{0, 1, 2, \ldots\}$,

$$\mathtt{f}_h^i(a) = \begin{cases} w(a) & \text{if } i = 0; \\ \frac{w(a)}{1 + \sum_{b_i \in \mathtt{Att}_\mathbf{G}(a)} \mathtt{f}_h^{i-1}(b_i)} & \text{otherwise.} \end{cases}$$

By convention, if $\mathtt{Att}_\mathbf{G}(a) = \emptyset$, $\sum_{b_i \in \mathtt{Att}_\mathbf{G}(a)} \mathtt{f}_h^{i-1}(b_i) = 0$.

Properties of weighted h-categorizer

Theorem

The function $\mathtt{f}_h^i$ *converges as* i *approaches infinity.*

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The function $\mathtt{f}^i_h$ converges as i approaches infinity.

Definition (Hbs)

The weighted h-categorizer semantics is a function Hbs transforming any WAG $\mathbf{G} = \langle \mathcal{A}, w, \mathcal{R} \rangle$ into a vector $\mathtt{Deg}^{\mathtt{Hbs}}_{\mathbf{G}}$ in $[0, 1]^n$, with $n = |\mathcal{A}|$ and for any $a \in \mathcal{A}$, $\mathtt{Deg}^{\mathtt{Hbs}}_{\mathbf{G}}(a) = \lim_{i \to +\infty} \mathtt{f}^i_h(a)$.

Characterisation of *h*-categorizer

Theorem

For each a, there is a unique value $\mathtt{Deg}(a)$ *such that*

$$\mathtt{Deg}(a) = \frac{w(a)}{1 + \sum_{b_i \in \mathtt{Att}(a)} \mathtt{Deg}(b)}$$

That value is equal to the score attributed by weighted h-categorizer, i.e.

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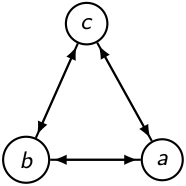
Exercise : which postulates are satisfied by weighted h-categorizer?

Exercise: calculate the scores wrt. *h*-categorizer



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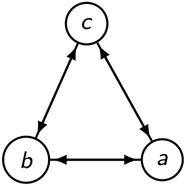

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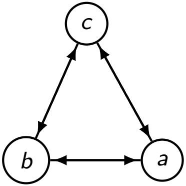

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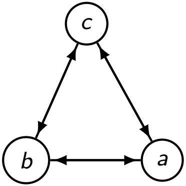

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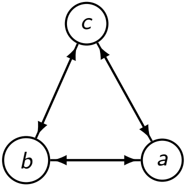

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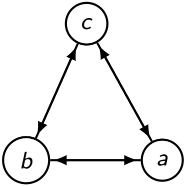

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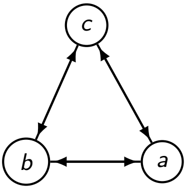

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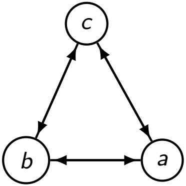

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thus, $\text{Deg}(a) = \text{Deg}(b) = \text{Deg}(c) = 0.5$

Trust-based semantics

- Da Costa et al. (IJCAI'11)
- Input: $\mathbf{G} = \langle \mathcal{A}, w, \mathcal{R} \rangle$, where $w(.)$ expresses the degree of trustworthiness of argument's source

$$\mathtt{Deg}^{TB}_{\mathbf{G}}(a) = \lim_{i \to +\infty} f_i(a), \text{ where } f_0(a) = w(a), \textit{and}$$

$$f_i(a) = \frac{1}{2} f_{i-1}(a) + \frac{1}{2} \min[w(a), 1 - \max_{b \in \mathtt{Att}(a)} f_{i-1}(b)]$$

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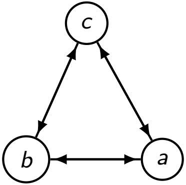

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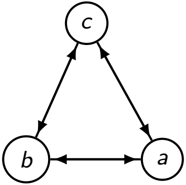

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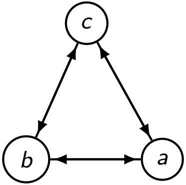

$\mathtt{Deg}^{TB}_{\mathbf{G}}(a) = \mathtt{Deg}^{TB}_{\mathbf{G}}(b) = \mathtt{Deg}^{TB}_{\mathbf{G}}(c) = 0.5$,
but also $\mathtt{Deg}^{TB}_{\mathbf{G}}(a) = 0.9$, $\mathtt{Deg}^{TB}_{\mathbf{G}}(b) = \mathtt{Deg}^{TB}_{\mathbf{G}}(c) = 0.1$

Exercise

Which properties are satisfied by TB semantics?

Social Abstract Argumentation Framework (SAF)

Leite and Martins (IJCAI'11)

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e The author of d is wrong. I found the author of (c) knows about that but withheld the information. Here's a link to another thread proving it!

Social Abstract Argumentation Framework (SAF)

- Each argument receives positive and negative votes
- Votes of argument a are aggregated $\tau(a) = \frac{v^+}{v^+ + v^- + \epsilon}$
- Simple product semantics:
- $\texttt{Deg}(a)^{SAF}_{\mathbf{G}} = \tau(a) \cdot (1 - (\texttt{Deg}^{SAF}_{\mathbf{G}}(b_1) \curlyvee \ldots \curlyvee \texttt{Deg}(b_n)))$, where
  - $b_1 \ldots b_n$ are the attackers of a
  - $x \curlyvee y = x + y - x \cdot y$

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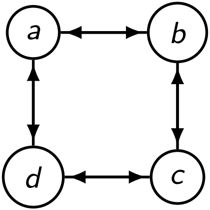
Attention, the scores wrt. SAF are not unique
All arguments: 1 positive and no negative votes, $\epsilon = 0.1$



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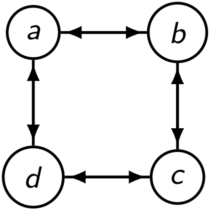
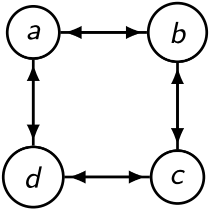


	a	*b*	*c*	*d*
model 1	0.36573	0.36573	0.36573	0.36573

Social Abstract Argumentation Framework (SAF)

Attention, the scores wrt. SAF are not unique
All arguments: 1 positive and no negative votes, $\epsilon = 0.1$



	a	*b*	*c*	*d*
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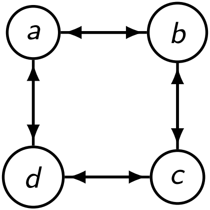

	a	b	c	d
model 1	0.36573	0.36573	0.36573	0.36573
model 2	0.01125	0.88875	0.01125	0.88875

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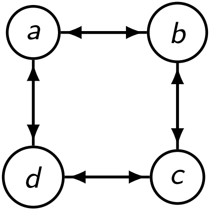

	a	*b*	*c*	*d*
model 1	0.36573	0.36573	0.36573	0.36573
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model 3		0.01125		0.01125

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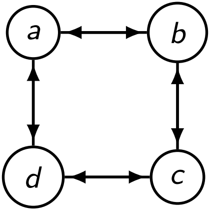

	a	b	c	d
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Iterative schema (Gabbay and Rodrigues)

- Input: $\mathbf{G} = \langle \mathcal{A}, w, \mathcal{R} \rangle$
- A single labeling for every graph
- Not really a ranking-based semantics:
  - the only scores are 0, 0.5 and 1
  - the result is a single extension made of arguments having score 1
- The value of each argument is the $\lim_{i \to +\infty} g_i(a)$, where

$$g_i(a) = (1 - g_{i-1}(a)) \min\left\{\frac{1}{2}, 1 - \max_{b \in \mathtt{Att}(a)} g_{i-1}(b)\right\} + g_{i-1}(a) \max\left\{\frac{1}{2}, 1 - \max_{b \in \mathtt{Att}(a)} g_{i-1}(b)\right\}$$

with $g_0(a_i) = w(a_i)$

Iterative schema (Gabbay and Rodrigues)

- Converges towards a labeling ...

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- $w(a) = 0.99$, $w(b) = 0.01$
- we obtain $\mathtt{Deg}(a) = \mathtt{Deg}(b) = 0.5$

DF-Quad

- Rago, Toni, Aurisicchio, Baroni (KR'16)
- this semantics is defined for acyclic graphs only
- it can also take into account the supports

$$\mathtt{Deg}(a) = w(a) \cdot \prod_{b \in \mathtt{Att}(a)} (1 - \mathtt{Deg}(b))$$

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Which postulates are satisfied?

Mbs and Cbs

- Amgoud, Ben-Naim, Doder, Vesic (IJCAI'17)
- Mbs looks only at the strongest attacker
- Cbs looks at the cardinality of attackers

Variable depth propagation

- Bonzon, Delobelle, Konieczny, Maudet (SUM'17)
- Applications in persuasion
  - Fading: long lines of argumentation become ineffective in practice
  - Procatalepsis: anticipating the counter-arguments of an audience to strengthen his own arguments

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  - Procatalepsis: anticipating the counter-arguments of an audience to strengthen his own arguments
- Their goal: define a semantics that satisfies both those principles

A sales pitch intended to persuade someone to buy a car

Example extended from Besnard & Hunter

(a1) The car x is a high performance family car with a diesel engine and a price of 32000 euros

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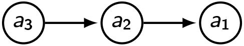

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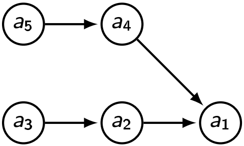
(a4) In addition, even if the price of the car seems high

(a5) It will be amortized because the diesel engines run longer before breaking than any kind of engines.



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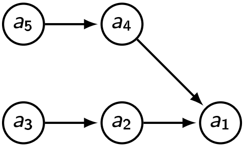

$\Rightarrow$ Contradicts VP

Delobelle SUM 2017

The valuation P of $a \in \texttt{Arg}$ at step i :

$$P_i^{\epsilon,\delta}(a) = \begin{cases} v_\epsilon(a) & \textit{if } \mathrm{i} = 0 \\ P_{i-1}^{\epsilon,\delta}(a) + (-1)^i \delta^i \sum\limits_{b \in \texttt{Att}_i(a)} v_\epsilon(b) & \textit{otherwise} \end{cases}$$

- $\delta \in [0,1]$ is the attenuation factor
- $v : \texttt{Arg} \to \mathbb{R}^+$ is a valuation function, with $\epsilon \in [0,1]$, s.t. $\forall b \in \texttt{Arg}$:

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Propagation number of a: $P^{\epsilon,\delta}(a) = \lim\limits_{i \to +\infty} P_i^{\epsilon,\delta}(a)$

Variable-depth propagation (vdp)

Definition

Variable-depth propagation (vdp) Let $\epsilon \in (0,1]$ and $\delta \in (0,1)$.
The ranking-based semantics **Variable-Depth Propagation** $\text{vdp}^{\epsilon,\delta}$ associates to any argumentation framework $\langle \texttt{Arg}, \texttt{Att} \rangle$ a ranking $\succeq$ on $\texttt{Arg}$ such that $\forall x, y \in \texttt{Arg}$:

$$x \succeq y \text{ iff } \begin{cases} P^{0,\delta}(x) > P^{0,\delta}(y) \\ \text{or} \\ (P^{0,\delta}(x) = P^{0,\delta}(y) \text{ and } P^{\epsilon,\delta}(x) \geq P^{\epsilon,\delta}(y)) \end{cases}$$

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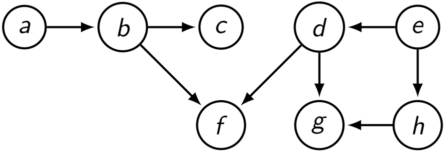
The ranking does not depend on ϵ.

Variable-depth propagation vdp$^\delta$ ($\epsilon = 0.7$ and $\delta = 0.5$)



$P_i^{0,0.5}$	a, e	b, d, h	c	f	g
0	1	0	0	0	0
1	1	-0.5	0	0	0
2	1	-0.5	0.25	0.5	0.25

$P_i^{0.7,0.5}$	a, e	b, d, h	c	f	g
0	1	0.7	0.7	0.7	0.7
1	1	0.2	0.35	0	0
2	1	0.2	0.525	0.5	0.25

$$a \simeq b \simeq c \simeq d \simeq e \simeq f \simeq g \simeq h$$

Theorem

Let $\delta^M = \sqrt{\frac{1}{\max_{a \in \mathtt{Arg}}(|\mathtt{Att}_2(a)|)}}$, *if* $\delta < \delta^M$ *then* vdp$^\delta$ *satisfies VP,*
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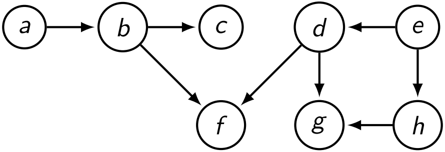

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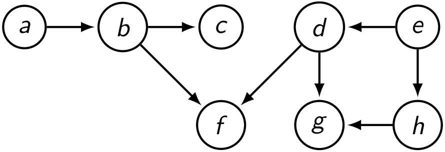

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$$\text{vdp}^{0.5}(\mathcal{AF}) = a \simeq e \succ f \succ c \succ g \succ b \simeq d \simeq h$$

Theorem

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other semantics

- Tuples (Cayrol, Lagasquie-Schiex, JAIR, 2005)
- A game-theoretic measure (Matt, Toni, JELIA'08)
- Graded acceptability (Grossi and Modgil, IJCAI'15)

Seeing extension-based semantics as ranking-based

- Input:
  - $\langle \mathcal{A}, w, \mathcal{R} \rangle$
  - a Dung's semantics **S** (e.g. preferred semantics)
- PAFs (Amgoud et Cayrol, Bench-Capon, Modgil)
- Do not manipulate weights but a preference relation

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- Do not manipulate weights but a preference relation

1. $a \succeq b$ iff $w(a) \geq w(b)$
2. Delete the attack from a to b if and only if $b \succ a$
3. Obtain a new attack relation $\mathcal{R}'$
4. Apply Dung's semantics on $\langle \mathcal{A}, \mathcal{R}' \rangle$
5. Attach acceptability degrees (Amgoud and Ben-Naim, KR'16)
   - if a belongs to all extensions, $\mathtt{Deg}(a) = 1$
   - else, if a belongs to at least one extension, $\mathtt{Deg}(a) = 0.5$
   - else, if a is not attacked by any extension, $\mathtt{Deg}(a) = 0.3$
   - else, $\mathtt{Deg}(a) = 0$

Exercise: preferred semantics

Does preferred semantics satisfy Neutrality?

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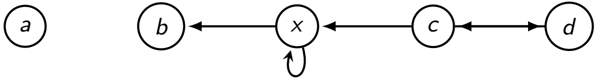

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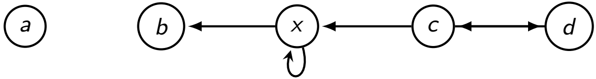

- What do we learn?
- Are the acceptability degrees of direct attackers sufficient to determine my acceptability degree?
- Do you agree with this hypothesis?

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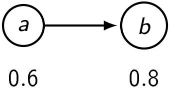

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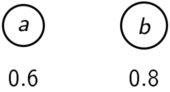

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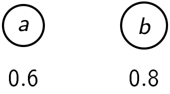
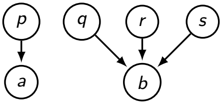


- What do you think?
- Is there an issue or just another philosophy behind this semantics?
- What about the way we handle the preferences / transform preferred semantics to a ranking-based one?

Table with all semantics and all principles

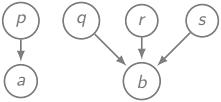
	GR	ST	PR	CO	IS	QuAD	TB	Mbs	Cbs	Hbs
Anonymity	•	•	•	•	•	•	•	•	•	•
Independence	•	×	•	•	•	•	•	•	•	•
Directionality	•	×	•	•	•	•	•	•	•	•
Neutrality	•	•	×	×	•	•	•	•	•	•
Equivalence	×	×	×	×	•	•	•	•	•	•
Maximality	×	×	×	×	×	•	•	•	•	•
Weakening	×	×	×	×	×	•	×	•	•	•
Counting	×	×	×	×	×	•	×	×	•	•
Weakening sound.	•	×	×	×	•	•	•	•	•	•
Proportionality	×	×	×	×	×	•	×	•	•	•
Reinforcement	×	×	×	×	×	•	×	×	•	•
Resilience	×	×	×	×	×	×	×	•	•	•
Cardinality Prec.	×	×	×	×	×	×	×	×	•	×
Quality Prec.	×	×	×	×	•	×	×	•	×	×
Compensation	•	•	•	•	×	•	•	×	×	•

On the notion of compensation



$\mathcal{F}_1$

On the notion of compensation



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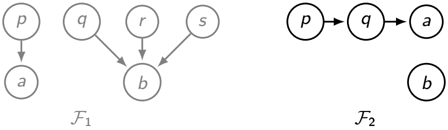

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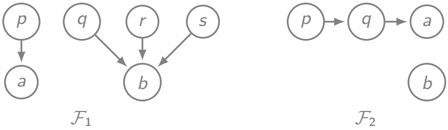

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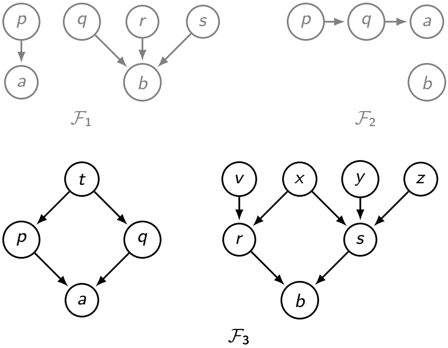

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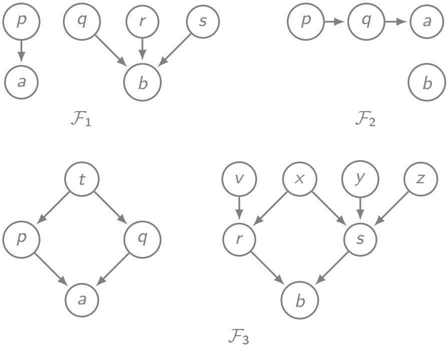

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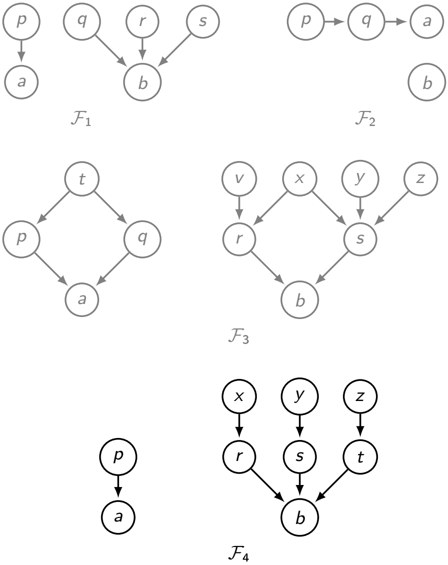

A parametrised ranking-based semantics

- Define a semantics based on a parameter

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- $\alpha-\texttt{BBS}$ semantics (Amgoud et al., KR'16)

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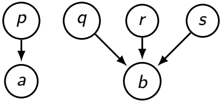
- Allow the user to choose to which extent to take into account
  - the strength of attackers
  - the number of attackers
- $\alpha-\texttt{BBS}$ semantics (Amgoud et al., KR'16)
- Inspired by burden-based semantics (the score is the burden)

Definition (s_α)

Let $\alpha \in (0, +\infty)$.We define $s_\alpha : \mathcal{A} \to [1, +\infty)$ such that $\forall a \in \mathcal{A}$,

$$s_\alpha(a) = 1 + \left(\sum_{b \in \texttt{Att}(a)} \frac{1}{(s_\alpha(b))^\alpha} \right)^{1/\alpha}$$

How does α−BBS work?



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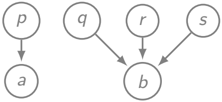

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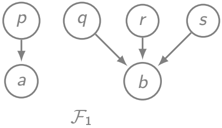
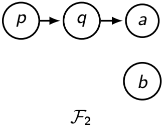
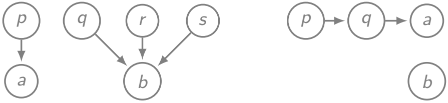


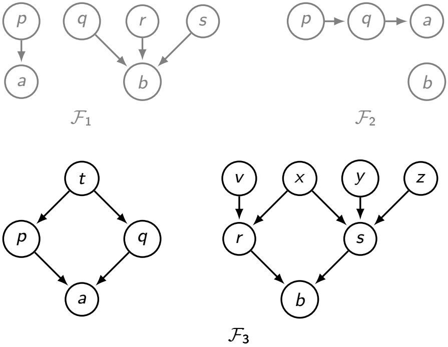


How does $\alpha-$BBS work?



$\mathcal{F}_1$ $\mathcal{F}_2$

How does α−BBS work?



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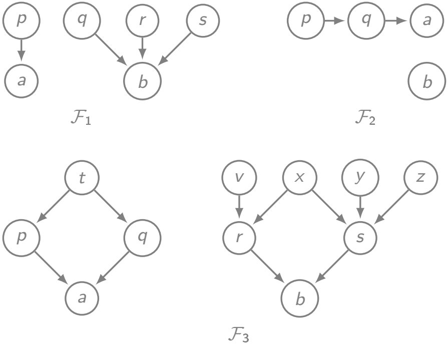
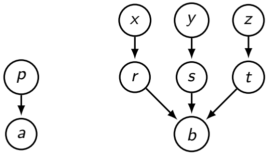


How does the compensation work?



$\mathcal{F}_4$

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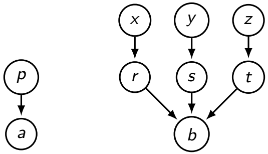

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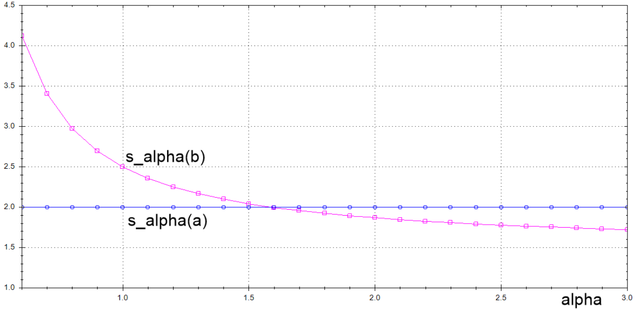

Existence and uniqueness of s_α

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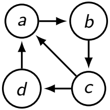
Theorem

For every argumentation graph, for every $\alpha \in (0, +\infty)$, s_α exists and is unique.

How to calculate s_α in practice?



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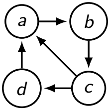

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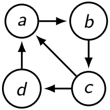

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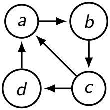

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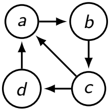

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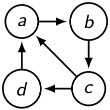

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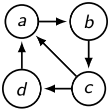

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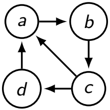

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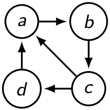

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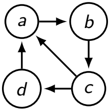

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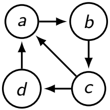

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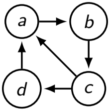

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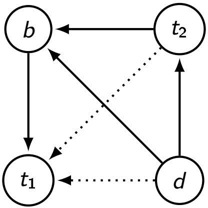
On the notion of support

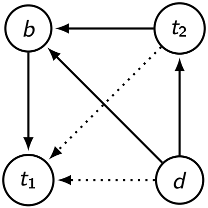
Amgoud et al., (International Journal Of Intelligent Systems, 2008)

- t1 Today we have time, we begin a hike.
- b The weather is cloudy, clouds are sign of rain, we better cancel the hike.
- t2 These clouds are early patches of mist, the day will be sunny, without clouds, so the weather will be not cloudy.
- d These clouds are not early patches of mist, so the weather will be not sunny but cloudy; however these clouds will not grow, so it will not rain.



- How to calculate extensions / ranking?

How to calculate the scores in bipolar frameworks?



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- Aggregate attacks / supports by using *max* (or -1 if no attack / support)
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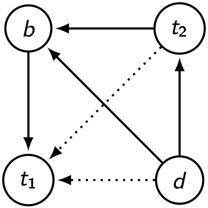

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Principles for bipolar frameworks

- Amgoud and Ben-Naim (ECSQARU'17)
- $\langle \mathcal{A}, w, \mathcal{R}, \mathcal{S} \rangle$
- Some principles are straightforward translations of the existing ones
  - just consider $\mathcal{R} \cup \mathcal{S}$ instead of $\mathcal{R}$
  - Independence
  - Directionality
  - ...

Principles for bipolar frameworks

- Stability: if a has no attackers and no supporters, $\texttt{Deg}(a) = w(a)$
- Neutrality: adding one attack or support from x to a such that $\texttt{Deg}(x) = 0$ does not change $\texttt{Deg}(a)$
- Franklin: adding one attacker x and one supporter y does not change the degree if $\texttt{Deg}(x) = \texttt{Deg}(y)$

Example: Euler-based semantics

$$\texttt{Deg}(a) = 1 - \frac{1 - w(a)^2}{1 + w(a)e^s}$$

where $s = \sum_{x \in \texttt{Supp}} \texttt{Deg}(x) - \sum_{x \in \texttt{Att}(a)} \texttt{Deg}(x)$

Studying classes of bipolar semantics

- Mossakowski & Neuhaus (arxiv, 2018)
- The notion of neutral element $[0, 1]$ vs. $[-1, 1]$
- The notion of modular semantics:

$$\mathtt{Deg}_{(G,w)}(a_i) = i(\alpha(G_i, \mathtt{Deg}_{(G,w)}), w(a_i))$$

  - First, calculate the impact of all attacks and supports: function α aggregating them into a single real number
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- All existing bipolar semantics are modular

Studying classes of bipolar semantics

- Continuity-α: $\alpha(g, .)$ is continuous
- Continuity-i: i is continuous
- Stickiness-min: $i(s, min_s) = min_s$
- Stickiness-max: $i(s, max_s) = max_s$
- Symmetry: $\alpha(g, d) = \alpha(-g, -d)$
    - swapping attackers for supporters and vice versa and multipying their degrees with -1 gives the same result

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- Proposition of several semantics where $\alpha = top$, which converge

Summary

- Extension-based semantics
- Ranking-based semantics
- Principles
- Semantics
- Bipolar frameworks

Questions

- Time for discussion, questions or exercises