

EXPRESSING AGENT-OPINIONS

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1 INTRODUCTION

- Background

2 A LOGIC OF OPINIONS

- A modal hybrid framework for opinions
- Some relations between opinions

3 OPINIONS, BELIEFS AND PREFERENCES ON AGENTS

- Extending the framework
- Some relations between opinions and beliefs

4 SUMMARY

- Conclusions and further work

OPINION

A belief or judgment that rests on insufficient grounds.

- Opinions about facts.
- Opinions about agents.

Main concern: How these opinions **relate** with each other?

AN EXAMPLE

Suppose you (Y) are sitting in an office without windows. Next to you is a colleague (C), inside the same office. Simultaneously, you are talking on the phone with a friend (F), who is sitting in a street café.

F: *"Everything your colleague says is false; the sun is shining!"*

C: *"Everything your friend says is false; it is raining!"*

- How to represent such **opinions**?
- Which is a suitable **logical language** to talk about such representation?

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OPINION MODELS

PROP a **finite** set of atomic propositions, NOM a set of world-names (nominals), AG a **finite** set of agent-names.

OPINION MODEL

A graph-like structure $M = \langle W, A, R^+, R^-, O^+, O^-, V, N \rangle$ where

- nodes are given by $W \cup A$ (**world-nodes** and **agent-nodes**),
- $R^+ \subseteq (A \times W)$, $R^- \subseteq (A \times W)$ (agent's **opinions** about **facts**),
- $O^+ \subseteq (A \times A)$, $O^- \subseteq (A \times A)$ (agent's **opinions** about **agents**),
- $V : (\text{PROP} \cup \text{NOM}) \rightarrow \wp(W)$ a **valuation** with $|V(i)| = 1$ for $i \in \text{NOM}$,
- $N : \text{AG} \rightarrow A$ an injection **naming** agent-nodes.

Some restrictions apply when we look for completeness results.

AN OPINION MODEL

$PROP := \{s\}$

$AG := \{y, f, c\}$

$W := \{w_1, w_2\}$

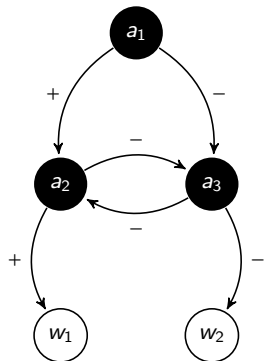
$A := \{a_1, a_2, a_3\}$

$R^+ := \{(a_2, w_1)\}$

$R^- := \{(a_3, w_2)\}$

$O^+ := \{(a_1, a_2)\}$

$O^- := \{(a_1, a_3), (a_2, a_3), (a_3, a_2)\}$



AN OPINION MODEL

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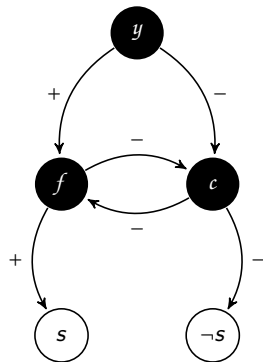
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MAIN DIFFERENCES W.R.T. KRIPKE MODELS

- Two kinds of nodes (and hence, two “valuations”).
- Agents are **nodes**!
- Two kinds of relations: opinions about **facts** and opinions about **agents**.
- **Two** relations for each kind of opinions.
- Opinions are **global** notions!

$$\varphi ::= p \mid i \mid \neg\varphi \mid \varphi \vee \psi \mid \boxplus_a\varphi \mid \boxminus_a\varphi \mid \oplus_{a:b} \mid \ominus_{a:b} \mid @_i\varphi$$

with $p \in \text{PROP}$, $i \in \text{NOM}$ and $a, b \in \text{AG}$

$\boxplus_a\varphi$: Agent a has a **positive** opinion about φ .

$\boxminus_a\varphi$: Agent a has a **negative** opinion about φ .

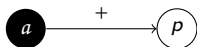
$\oplus_{a:b}$: Agent a has a **positive** opinion about agent b .

$\ominus_{a:b}$: Agent a has a **negative** opinion about agent b .

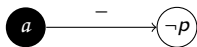
SEMANTIC INTERPRETATION

For $p \in \text{PROP}$, \neg , \vee is a usual. For the rest,

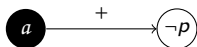
$(M, w) \models i$	iff	$\{w\} = V(i)$
$(M, w) \models \boxplus_a \varphi$	iff	for all $u \in W$, $R^+ N(a)u$ implies $(M, u) \models \varphi$
$(M, w) \models \boxminus_a \varphi$	iff	for all $u \in W$, $R^- N(a)u$ implies $(M, u) \models \neg \varphi$
$(M, w) \models \oplus_{a:b}$	iff	$O^+ N(a)N(b)$
$(M, w) \models \ominus_{a:b}$	iff	$O^- N(a)N(b)$
$(M, w) \models \odot_i \varphi$	iff	$(M, u) \models \varphi$, where $V(i) = \{u\}$



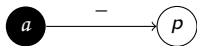
$\boxplus_a p$: a has **positive** opinion about p .



$\boxminus_a p$: a has **negative** opinion about p .

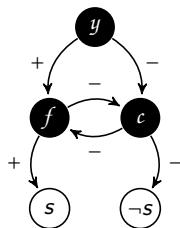


$\boxplus_a \neg p$: a has **positive** opinion about $\neg p$.



$\boxminus_a \neg p$: a has **negative** opinion about $\neg p$.

OUR PREVIOUS MODEL

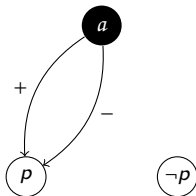


$\boxplus_f s \wedge \boxminus_c s$: Agent f has a **positive** opinion about s and agent c has a **negative** opinion about s .

$\ominus_{f:c} \wedge \ominus_{c:f}$: f and c have both a **negative** opinion about each other.

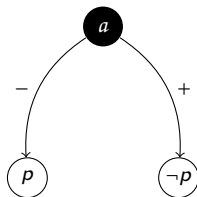
$\oplus_{y:f} \wedge \ominus_{y:c}$: You have a **positive** opinion about f and a **negative** one about c .

BUT IT MAY BE STRONGER

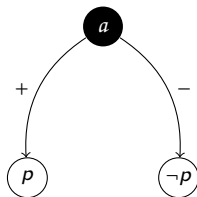


$\boxplus_a p \wedge \boxminus_a \neg p$: **Positive opinion** about p and **negative opinion** about $\neg p$.

ALSO



$\neg \boxplus_a p \wedge \neg \boxminus_a p$: **No opinion** (neither positive nor negative) about p .



$\boxplus_a p \wedge \boxminus_a p$: **Both opinions** (positive and negative) about p .

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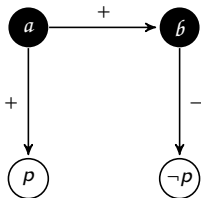
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“INCONSISTENT” OPINIONS



$\boxplus_a p \wedge \oplus_{a:b} \wedge \boxminus_b p$: a has a positive opinion about both p and b ,
but b has a negative opinion about p .

SOME POSTULATES

- P1** Opinions about agents to whom we have positive and negative opinions influence **positive** opinions about facts.
- P2** Opinions about agents to whom we have positive and negative opinions influence **negative** opinions about facts.
- P3** Similar opinions about facts lead to **positive** opinions between agents.
- P4** Opposite opinions about facts lead to **negative** opinions between agents.

THEIR SYNTACTIC COUNTERPART

- $\text{Pos}_{\text{AG}}(a) := \{b \in \text{AG} \mid O^+ N(a) N(b)\}$
- $\text{Neg}_{\text{AG}}(a) := \{b \in \text{AG} \mid O^- N(a) N(b)\}$
- $\text{Pos}_{\text{PROP}}(a) := \{p \in \text{PROP} \mid R^+ N(a) u \text{ implies } u \in V(p)\}$
- $\text{Neg}_{\text{PROP}}(a) := \{p \in \text{PROP} \mid R^- N(a) u \text{ implies } u \notin V(p)\}$

$$\mathbf{A1} \quad \left(\bigwedge_{b \in \text{Pos}_{\text{AG}}(a)} \boxplus_b p \wedge \bigwedge_{b \in \text{Neg}_{\text{AG}}(a)} \boxminus_b p \right) \rightarrow \boxplus_a p$$

$$\mathbf{A2} \quad \left(\bigwedge_{b \in \text{Pos}_{\text{AG}}(a)} \boxminus_b p \wedge \bigwedge_{b \in \text{Neg}_{\text{AG}}(a)} \boxplus_b p \right) \rightarrow \boxminus_a p$$

$$\mathbf{A3} \quad \left(\bigwedge_{p \in \text{Pos}_{\text{PROP}}(a)} \boxplus_b p \wedge \bigwedge_{p \in \text{Neg}_{\text{PROP}}(a)} \boxminus_b p \right) \rightarrow \oplus_{a:b}$$

$$\mathbf{A4} \quad \left(\bigwedge_{p \in \text{Pos}_{\text{PROP}}(a)} \boxminus_b p \wedge \bigwedge_{p \in \text{Neg}_{\text{PROP}}(a)} \boxplus_b p \right) \rightarrow \ominus_{a:b}$$

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ADDING BELIEFS TO THE PICTURE

- Conceptual differences between opinions and beliefs.
- Technical differences between them: opinion is global, belief is local.
- Nesting of opinions is meaningless; nesting of beliefs is relevant.

OPINION MODEL

A graph-like structure

$M = \langle W, A, R^+, R^-, O^+, O^-, \{R_a \mid a \in AG\}, \{\leq_a \mid a \in AG\}, V, N \rangle$ where

- $R_a \subseteq (W \times W)$ is a **serial, transitive and euclidean** relation for each agent-name a ,
- $\leq_a \subseteq (A \times A)$ is a **reflexive and transitive** relation for each agent-name a .

LANGUAGE AND SEMANTIC INTERPRETATION

$(M, w) \models B_a \varphi$	iff	for all $u \in W$ s.t. $R_a wu$, we have $(M, u) \models \varphi$
$(M, w) \models a \leq_c b$	iff	$N(a) \leq_c N(b)$

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SOME POSTULATES RELATING OPINIONS AND BELIEFS

P5 Opinions about agents lead to preferences about agents.

$$(\oplus_{a:b} \wedge \ominus_{a:c}) \rightarrow c \leq_a b$$

P6 Preferences about agents and opinions about facts of those agents can lead to **positive** opinions about facts.

$$(c \leq_a b \wedge \boxplus_b \varphi \wedge \boxminus_c \varphi) \rightarrow \boxplus_a \varphi$$

P7 Preferences about agents and opinions about facts of those agents can lead to **negative** opinions about facts.

$$(c \leq_a b \wedge \boxminus_b \varphi \wedge \boxplus_c \varphi) \rightarrow \boxminus_a \varphi$$

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- Language and semantic model for representing opinions about facts and about agents.
- Postulates stating some relations between opinions.
- Extension with beliefs and preferences over agents.
- Postulates for some relations between the different notions.

TO DO

- Other postulates for relations between the concepts.
- Dynamic look at these “reasonable” properties.

Thanks!