Fostering Explainable Online Review Assessment Through Computational Argumentation

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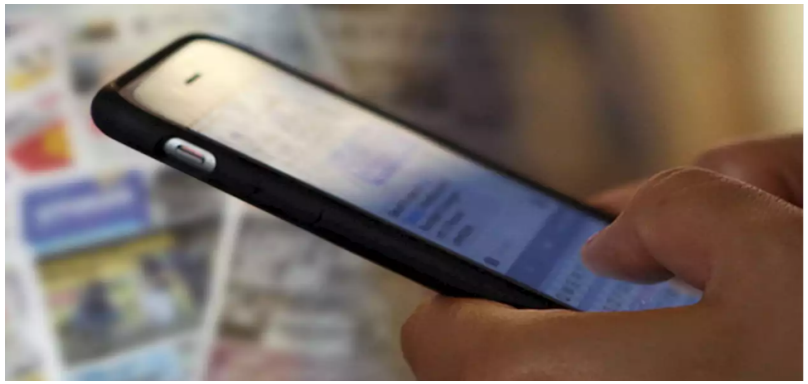
Motivation



AI Research Question

1. How to evaluate the quality of online information?
2. How to explain the assessment of the quality of the online information?

Argumentation

1. review assessment [Ceolin et al., 2021]
2. explainable [Cyras et al., 2021, Vassiliades et al., 2021]

Motivation Question

How can argumentation be used for explanation of the review quality?

Contribution

Main Contributions

- Argumentation formalisms
  - for assessing the quality of the reviews
  - for explaining the assessment
- Abstract argumentation frameworks
  - Argument
  - Attack relation
  - Grounded semantics
  - Explaining
  - Evaluating the score of the reviews

Outline

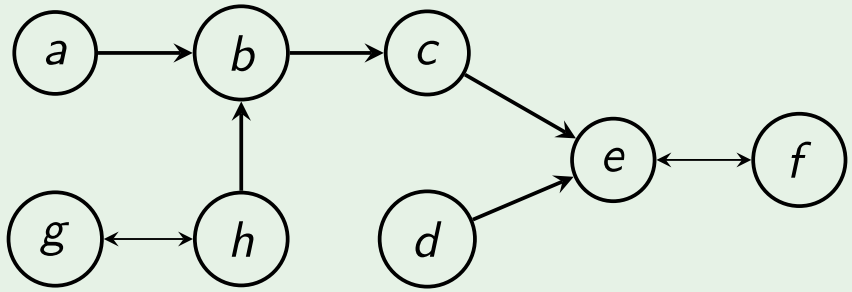
Background

Definition

An *argumentation framework* F is a pair (A, R) such that [Dung, 1995]

- A is a finite set of arguments
- $R \subseteq A \times A$ is a binary relation representing attacks between arguments

Example

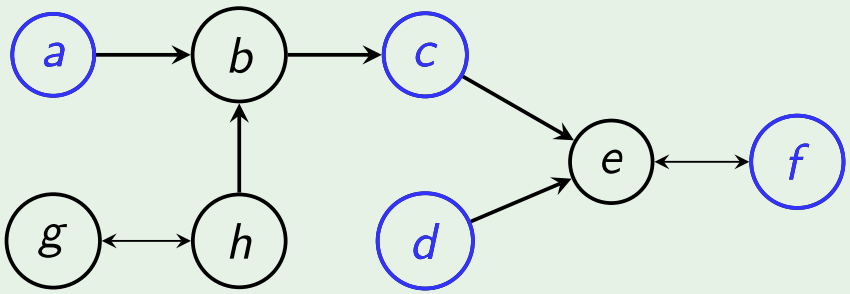


- Semantics: Solution concepts to define the acceptance of arguments
- Extension: A set of jointly accepted arguments

Background

- An argument $a \in A$ is *defended* by $S \subseteq A$ (in F) if $\forall c \in A$: if $(c, a) \in R$ then $\exists b \in S$ such that $(b, c) \in R$
- $\Gamma_F(S) = \{a \in A \mid a \text{ is defended by } S \text{ in } F\}$
- S is the grounded extension if S is the $\subseteq$-least fixed point of Γ_F

Example



$grd(F) = \{\{a, c, d, f\}\}$

- $F = (A, R)$ is *acyclic*: if there is no $a_1, \ldots, a_i \in A$ s.t. $(a_{i+1}, a_i) \in R$
- [Dung, 1995] Acyclic AF: all sets of semantics coincide

Modeling Reviews with AFs

Reviews

- Let t be a product
- let $\{r_{t1}, \ldots, r_{tn}\}$ be a set of reviews of t
- r_{ti} consists of a numerical score $sc(r_{ti})$ and a textual description
- list of all topics $\mathcal{T}_t = \{\phi_1, \ldots, \phi_n\}$
- $w(sc(r_{ti}), \phi, r_{ti})$: *initial weight* of ϕ in review r_{ti} and score $sc(r_{ti})$
- $[\phi]_k = \{r_{ti} \mid r_{ti}$ contains topic ϕ and $sc(r_{ti}) = k\}$
- $w([\phi]_k) = \Sigma_{i=1}^{n} w(k, \phi, r_{ti})$

Definition: Modeling Reviews with AFs

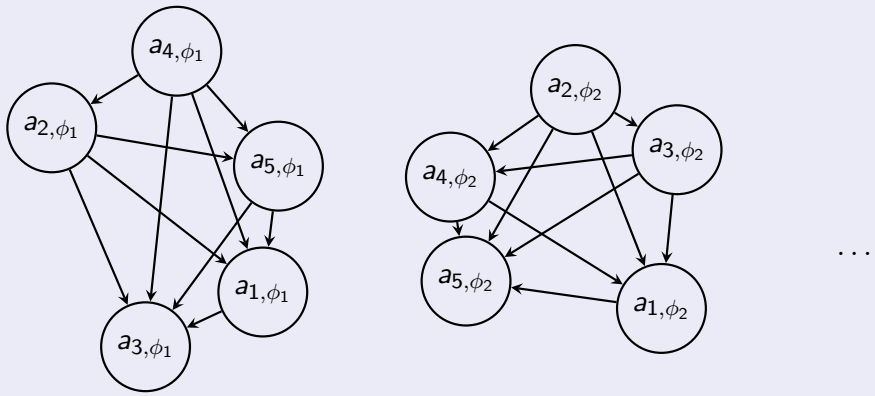
An AF constructed based on topics is $F = (A, R)$ where,

- $A = \{a_{i,\phi} = [\phi]_i\}$
- $R = \{(a_{i,\phi}, a_{j,\phi}) \mid a_{i,\phi}, a_{j,\phi} \in A$ and $w(a_{i,\phi}) > w(a_{j,\phi})\}$.

Theorem

Let F be an AF, constructed based on topics $\mathcal{T}_t$ of product t.
If $|\mathcal{T}_t| = m$ and $m > 1$, then

1. the associated graph of F is disconnected and it contains at least m connected component.



2. Every connected component is acyclic.
3. Every component has at least one initial argument.
4. The grounded extension of F, i.e., $grd(F)$ is none empty
5. $grd(F) = \{b \mid$ there is no $a \in A$ such that $(a, b) \in R\}$

What is an AI system explanation?

Definition

Let $F = (A, R)$ be an AF constructed based on topics of t, and let $\phi \in \mathcal{T}_t$

Score of a topic:

$$sc_{AI}(\phi) = \text{round}\left(\frac{\sum_{a_{i,\phi} \in grd(F)} i}{|\{i \mid a_{i,\phi} \in grd(F)\}|}\right)$$

Explanation of a score of a topic:

$$\text{Exp}(\phi, \text{sc}_{AI}(\phi)) = \{a_{i,\phi} \mid a_{i,\phi} \in grd(F)\}$$

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Explanation of a score of a topic:

$$\text{Exp}(\phi, \text{sc}_{AI}(\phi)) = \{a_{i,\phi} \mid a_{i,\phi} \in grd(F)\}$$

Score of a review:

$$\text{SC}_{AI}(\text{r}_{ti}) = \text{round}\left(\frac{\sum_{\phi \in \mathcal{T}_{t,\text{r}_{ti}}} \text{sc}_{AI}(\phi)}{|\mathcal{T}_{t,\text{r}_{ti}}|}\right)$$

Explanation of a score of a review:

$$\text{Exp}(\text{r}_{ti}, \text{SC}(\text{r}_{ti})) = \bigcup_{\phi \in \mathcal{T}_{t,\text{r}_{ti}}} \text{Exp}(\phi, \text{sc}_{AI}(\phi))$$

Summary

Summary

- We construct an AF based on a set of reviews
- Evaluate the score of topics in the grounded extension
- Explain the reason for choosing the associated score of a topic
- Accumulate function assigns a score to a review
- Explanation of a score of a review

Future work

- Study relations among reviews that do not have a common topic
- Work on temporal way of reasoning
- Consider user preferences over the topics of a product
- Extract AFs by combining human and automated computation

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