

A model for the Burden of Persuasion in Argumentation

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- 1 Motivations & Context
- 2 Running examples
- 3 Background notion: argumentation framework language
- 4 Labelling and burden of persuasion
 - Model
 - Examples
 - Reasoning over BP
- 5 Conclusion & Further Work



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Context

The issue of the burden of proof has a significance that goes beyond the law: public discourse, risk management, etc. – in which multiple agents, having different tasks and responsibilities, provide evidence and arguments

Burden of proof [Walton, 2014]

- distribute dialectical responsibilities between the parties of argumentation
- the party with the burden will fail to establish the claim unless the party provides the kind of argument or evidence that is required to meet the burden
- **burden of production** → necessity of providing evidence, in order to establish a claim
- **burden of persuasion** → necessity of providing a dialectically convincing argument

Motivation & Contribution I

- Model proposed by Prakken and Sartor according to which arguments for a claim burdened with persuasion will be strictly defeated unless they strictly prevail over arguments denying that claim
[Prakken and Sartor, 2010]
- Model of burdens in argumentation proposed by Gordon et al. assess the satisfaction of burdens of proofs based on the dialectical status of the concerned argument [Gordon et al., 2007]



Model for burden of persuasion in argumentation

- we not only consider whether the argument strictly prevails over counter arguments
- required that all (direct) subarguments are accepted

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Civil law example: medical malpractice



Criminal law example: self-defence in murder case



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Defeasible theories

We use ASPIC⁺-like language for structured argumentation [Prakken, 2010]

Defeasible rule ρ : $\phi_1, \dots, \phi_n, \sim \phi'_1, \dots, \sim \phi'_m \Rightarrow \psi$ with $0 \leq n$

- ρ is the unique identifier for r , denoted by $N(r)$
- $\phi_1, \dots, \phi_n, \phi'_1, \dots, \phi'_m \rightarrow \text{Antecedent}(r)$
- $\psi \rightarrow \text{Consequent}(r)$
- $\sim \phi$: weak negation

Superiority relation

$\succ$ over a set of rules $Rules$ is an antireflexive and antisymmetric binary relation over $Rules$, i.e., $\succ \subseteq Rules \times Rules$

Defeasible theory

A tuple $\langle Rules, \succ \rangle$ where $Rules$ is a set of rules, and $\succ$ is a superiority relation over $Rules$

Argumentation graphs I

Given a defeasible theory and by chaining rules $\rightarrow$ construct arguments

Argument A (cf. [Modgil and Prakken, 2014])

constructed from a defeasible theory $\langle Rules, \succ \rangle$ is a finite construct of the form: $A : A_1, \dots, A_n \Rightarrow_r \phi$ with $0 \leq n$, where

- A is the unique identifier of the argument
- $A_1, \dots, A_n$ are arguments from the defeasible theory $\langle Rules, \succ \rangle$
- ϕ is the *conclusion* of the argument, denoted $\text{Conc}(A)$
- $\text{TopRule}(A)$ denotes the the *top rule* of A , i.e. the last inference rule
- $\text{Sub}(A)$ denotes the *set of subarguments* of A
- $\text{DirectSub}(A)$ denotes the *direct subarguments* of A



Argumentation graphs II

Collision between arguments

- (a) contradicts the conclusion of another argument (**top-rebutting**)
 - A **strictly top-rebuts** B iff $A \succ B$
- (b) denies the (applications of the) latter's top rule or contradicts a weak negation in the latter's body (**top-undercutting**)
 - A **top-attacks** B iff A **top-rebuts** B or A **top-undercuts** B
 - A **strictly top-attacks** B iff A **strictly-top-rebuts** B or A **top-undercuts** B

Argumentation graph

A **argumentation graph** constructed from a defeasible theory T is a tuple $\langle \mathcal{A}, \rightsquigarrow \rangle$, where $\mathcal{A}$ is the set of all arguments constructed from T , and $\rightsquigarrow$ is an *attack* relation over $\mathcal{A}$.

Labelling semantics

$\{\text{IN}, \text{OUT}, \text{UND}\}$ -labelling of an argumentation graph

A total function $\mathcal{A}_G \rightarrow \{\text{IN}, \text{OUT}, \text{UND}\}$



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Burden of persuasion in argumentation

BP-labelling conditions: $\forall A \in \mathcal{A}_G$ with $\text{Conc}(A) = \phi$

- 1 $A \in L(\text{IN})$ iff
 - 1 $\bar{\phi} \in \text{BurdPers}$ and
 - 1 $\forall B \in \mathcal{A}_G$ such that B strictly top-attacks A : $B \in L(\text{OUT})$ and
 - 2 $\forall A' \in \text{DirectSub}(A)$: $A' \in L(\text{IN})$ or
 - 2 $\bar{\phi} \notin \text{BurdPers}$ and
 - 1 $\forall B \in \mathcal{A}_G$ such that B top-attacks A : $B \in L(\text{OUT})$ and
 - 2 $\forall A' \in \text{DirectSub}(A)$: $A' \in L(\text{IN})$
- 2 $A \in L(\text{OUT})$ iff
 - 1 $\phi \in \text{BurdPers}$ and
 - 1 $\exists B \in \mathcal{A}_G$ such that B top-attacks A and $B \notin L(\text{OUT})$ or
 - 2 $\exists A' \in \text{DirectSub}(A)$ such that $A' \notin L(\text{IN})$ or
 - 2 $\phi \notin \text{BurdPers}$ and
 - 1 $\exists B \in \mathcal{A}_G$ such that B strictly top-attacks A and $B \in L(\text{IN})$ or
 - 2 $\exists A' \in \text{DirectSub}(A)$: $A' \in L(\text{OUT})$;
- 3 $A \in L(\text{UND})$ otherwise.

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Civil law example: medical malpractice

BurdPers = {*dueDiligence*, *liable*}

$e1 : ev_1$

$er1 : ev_1 \Rightarrow \neg guidelines$

$r1 : guidelines \Rightarrow dueDiligence$

$e2 : ev_2$

$er2 : ev_2 \Rightarrow guidelines$

$r2 : harm, \sim dueDiligence \Rightarrow liable$

$e3 : ev_3$

$er3 : ev_3 \Rightarrow harm$

Corresponding arguments:

$A1 \Rightarrow ev_1$

$A4 : A1 \Rightarrow \neg guidelines$

$A7 : A5 \Rightarrow dueDiligence$

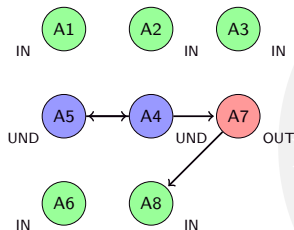
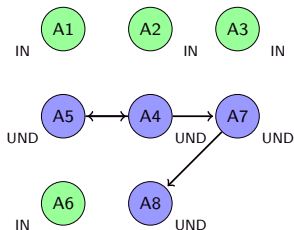
$A2 \Rightarrow ev_2$

$A5 : A2 \Rightarrow guidelines$

$A8 : A6 \Rightarrow liable$

$A3 \Rightarrow ev_3$

$A6 : A3 \Rightarrow harm$



Criminal law example: self-defence in murder case

$\text{BurdPers} = \{\text{murder}\}$

$f1: \Rightarrow \text{killed}$

$f3: \Rightarrow \text{threatWithWeapon}$

$r1: \text{threatWithWeapon} \Rightarrow \text{selfDefence}$

$r3: \text{selfDefence} \Rightarrow \neg \text{murder}$

$f2: \Rightarrow \text{intention}$

$f4: \Rightarrow \neg \text{threatWithWeapon}$

$r2: \neg \text{threatWithWeapon} \Rightarrow \neg \text{selfDefence}$

$r4: \text{killed}, \text{intention} \Rightarrow \text{murder}$

with $r3 \succ r4$. We can build the following arguments:

$A1: \Rightarrow \text{killed}$

$A2: \Rightarrow \text{intention}$

$A3: A1, A2 \Rightarrow \text{murder}$

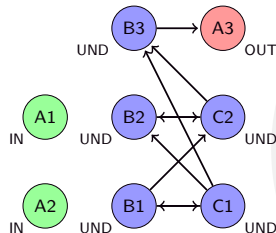
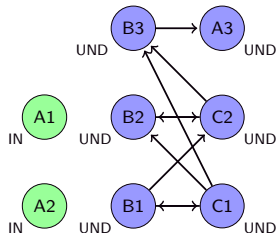
$B1: \Rightarrow \text{threatWithWeapon}$

$B2: B1 \Rightarrow \text{selfDefence}$

$B3: B2 \Rightarrow \neg \text{murder}$

$C1: \Rightarrow \neg \text{threatWithWeapon}$

$C2: C1 \Rightarrow \neg \text{selfDefence}$



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Reasoning over BP

- bp-statements part of the KB or be inferred from it

European nondiscrimination law

$e1 : ev1$

$er1 : ev1 \Rightarrow indiciaDiscrim$

$r1 : indiciaDiscrim \Rightarrow bp(\neg discrim)$

$e2 : ev2$

$er2 : ev2 \Rightarrow \neg discrim$

$e3 : ev3$

$er3 : ev3 \Rightarrow discrim$

- there are indicia of discrimination
- infer that there is the burden of proving nondiscrimination

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Conclusion

Preliminary exploration of the intersection between the burden of persuasion and argumentation labelling frameworks, and it can provide a starting point for further research:

- take into account different standards of proof that are required for meeting the burden of persuasion
- reasoning and argument over BP



References I



Gordon, T. F., Prakken, H., and Walton, D. (2007).
The carneades model of argument and burden of proof.
Artificial Intelligence, 171(10):875–896.



Modgil, S. and Prakken, H. (2014).
The *ASPIC*⁺ framework for structured argumentation: a tutorial.
Argument & Computation, 5(1):31–62.



Prakken, H. (2010).
An abstract framework for argumentation with structured arguments.
Argument and Computation, 1:93–124.



Prakken, H. and Sartor, G. (2010).
A logical analysis of burdens of proof.
Legal Evidence and Proof: Statistics, Stories, Logic, 1:223–253.



Walton, D. (2014).
Burden of proof, presumption and argumentation.
Cambridge University Press, USA.



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