

Burden of Persuasion in Argumentation

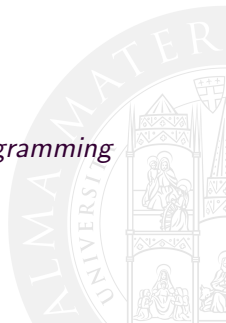
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- 1 Motivations & Context
- 2 Background notion: argumentation framework language
- 3 Running examples
 - Civil law example: medical malpractice
 - Criminal law example: self-defence in murder case
- 4 Labelling and burden of persuasion
 - Model
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- 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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Defeasible theories

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

Defeasible rule

has the form: $r: \phi_1, \dots, \phi_n \Rightarrow \phi$ with $0 \leq n$, and where

- r is the unique identifier of the rule, and
- each $\phi_1, \dots, \phi_n, \phi$ is a literal.

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

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 $Conc(A)$
- $TopRule(A)$ denotes the the *top rule* of A , i.e. the last inference rule
- $Sub(A)$ denotes the *set of subarguments* of A
- $DirectSub(A)$ denotes the *direct subarguments* of A



Labelling semantics

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

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

Complete $\{\text{IN}, \text{OUT}, \text{UND}\}$ -labelling

- A is IN iff all attackers of A are OUT,
- A is OUT iff A has (at least) an attacker IN.

Since $\{\text{IN}, \text{OUT}, \text{UND}\}$ -labellings are total functions, if an argument is not IN or OUT, then it is UND.

Grounded labelling

- $\text{IN}(L)$ is minimal

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Civil law example: medical malpractice

Let us consider the following rules:

r1: $\Rightarrow \neg \text{guidelines}$

r3: $\neg \text{guidelines} \Rightarrow \text{negligent}$

r5: $\Rightarrow \text{harm}$

r7: $\text{harm} \Rightarrow \text{liable}$

r2: $\Rightarrow \text{guidelines}$

r4: $\text{guidelines} \Rightarrow \neg \text{negligent}$

r6: $\neg \text{negligent} \Rightarrow \neg \text{liable}$

with $r6 \succ r7$. We can then build the following arguments:

A1 : $\Rightarrow \neg \text{guidelines}$

A2 : A1 $\Rightarrow \text{negligent}$

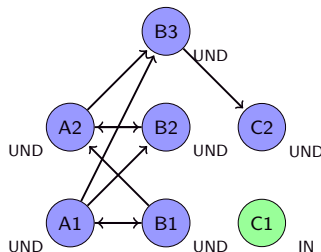
B1 : $\Rightarrow \text{guidelines}$

B2 : B1 $\Rightarrow \neg \text{negligent}$

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

C1 : $\Rightarrow \text{harm}$

C2 : C1 $\Rightarrow \text{liable}$



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Criminal law example: self-defence in murder case

Let us consider the following rules:

$r1: \Rightarrow killed$

$r3: \Rightarrow threatWithWeapon$

$r5: threatWithWeapon \Rightarrow selfDefence$

$r7: selfDefence \Rightarrow \neg murder$

$r2: \Rightarrow intention$

$r4: \Rightarrow \neg threatWithWeapon$

$r6: \neg threatWithWeapon \Rightarrow \neg selfDefence$

$r8: killed, intention \Rightarrow murder$

with $r7 \succ r8$. We can build the following arguments:

$A1: \Rightarrow killed$

$A2: \Rightarrow intention$

$A3: A1, A2 \Rightarrow murder$

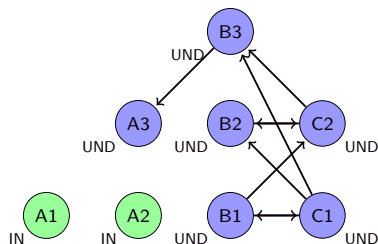
$B1: \Rightarrow threatWithWeapon$

$B2: B1 \Rightarrow selfDefence$

$B3: B2 \Rightarrow \neg murder$

$C1: \Rightarrow \neg threatWithWeapon$

$C2: C1 \Rightarrow \neg selfDefence$



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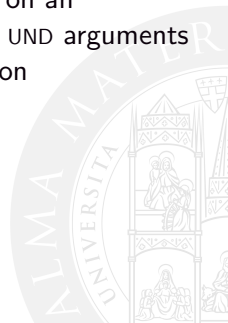
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Burden of persuasion in argumentation I

- $BP(\Phi) \rightarrow$ indicate there is a burden of persuasion on every literal in a set of literals Φ
- A burden of persuasion labelling (BP-labelling) based on an $\{IN, OUT, UND\}$ -labelling assigns OUT^* and IN^* labels to UND arguments depending on the allocation of the burden of persuasion
- the BP labelling is a total function



Burden of persuasion in argumentation II

BP-labelling conditions

1. if $A \in \text{IN}(L)$ then $A \in \text{IN}^*$;
2. if $A \in \text{OUT}(L)$ then $A \in \text{OUT}^*$;
3. if $A \in \text{UND}(L)$ then
 - (a) $A \in \text{IN}^*$ iff
 - i. $\bar{\phi} \in \Phi$ and
 - $\nexists B \in \mathcal{A}_G$ such that $\text{Conc}(B) = \bar{\phi}$, $B \succ A$ and B is IN^* and
 - $\nexists A' \in \text{DirectSub}(A) : A'$ is OUT^*
 - or
 - ii. $\bar{\phi} \notin \Phi$ and
 - $\forall B \in \mathcal{A}_G$ such that $\text{Conc}(B) = \bar{\phi}$, $A \not\succ B : B$ is OUT^* and
 - $\forall A' \in \text{DirectSub}(A) : A'$ is IN^* ;
 - (b) $A \in \text{OUT}^*$ iff
 - i. $\phi \in \Phi$ and
 - $\exists B \in \mathcal{A}_G$ such that $\text{Conc}(B) = \bar{\phi}$, $A \not\succ B$ and B is not OUT^* or
 - $\exists A' \in \text{DirectSub}(A) : A'$ is not IN^*
 - or
 - ii. $\phi \notin \Phi$ and
 - $\exists B \in \mathcal{A}_G$ such that $\text{Conc}(B) = \bar{\phi}$, $B \succ A$ and B is IN^* or
 - $\exists A' \in \text{DirectSub}(A) : A'$ is OUT^* ;
 - (c) $A \in \text{UND}^*$ otherwise.

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Civil law example: medical malpractice

BP($\neg$ *negligent*)

A1 : $\Rightarrow \neg$ *guidelines*

A2 : A1 $\Rightarrow$ *negligent*

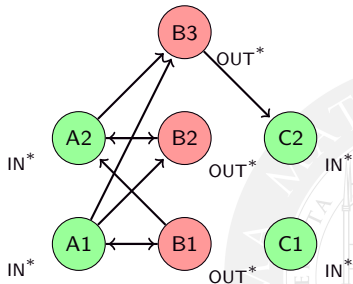
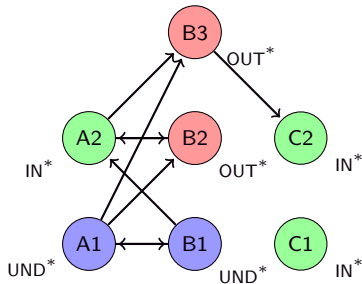
B1 : $\Rightarrow$ *guidelines*

B2 : B1 $\Rightarrow \neg$ *negligent*

B3 : B2 $\Rightarrow \neg$ *liable*

C1 : $\Rightarrow$ *harm*

C2 : C1 $\Rightarrow$ *liable*



Criminal law example: self-defence in murder case

$BP(\{killed, intention, \neg selfDefence\})$

$A1 : \Rightarrow killed$

$B1 : \Rightarrow threatWithWeapon$

$C1 : \Rightarrow \neg threatWithWeapon$

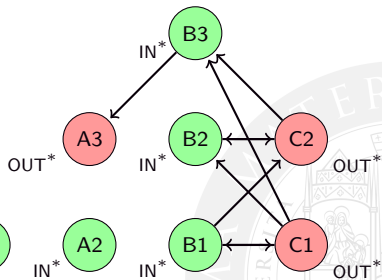
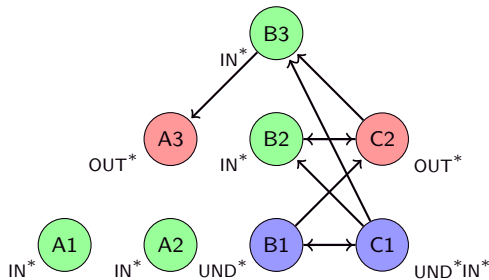
$A2 : \Rightarrow intention$

$B2 : B1 \Rightarrow selfDefence$

$C2 : C1 \Rightarrow \neg selfDefence$

$A3 : A1, A2 \Rightarrow murder$

$B3 : B2 \Rightarrow \neg murder$



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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



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