Towards a framework for the implementation and verification of translations between argumentation models

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1. Argumentation theory: a perceived problem

2. Overview of the work done
Outline

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Argumentation theory

Interdisciplinary area with various applications:
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Argumentation theory

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All these topics can give rise to *different notions of argument* and therefore *different argumentation models*. 
Abstract argumentation

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- Significant amount of models are an instantiation of Dung’s model (are translatable to)
- Relatively simple data structures/algorithms (complexity still NP or higher for most problems)
- Some recent efforts to optimise the evaluation of AFs (and Answer Set Programming)
A perceived problem

- Lack of (documented) implementations of more complex argumentation models
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A perceived problem

• Lack of (documented) implementations of more complex argumentation models
• Existing translations from complex models to Dung, however again a lack of implementations
  • Translations are complex
  • Proofs of correctness are complex (page long proofs)
A proposed solution

• Provide implementation of Dung and some other models (Carneades, ASPIC⁺)
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  • In a **tutorial-like** fashion,
  • Close to the actual **mathematical definitions**
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- Provide a formalisation of implementations and translation

Result: a verified way to translate models to an efficiently implemented model.
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2. Overview of the work done
An abstract argumentation framework (AF) is a tuple
\[ AF = \langle \text{Args}, \text{Def} \rangle \] such that:

- \text{Args} is a set of (abstract) arguments,
- \text{Def} \subseteq \text{Args} \times \text{Args}.

In other words a directed graph.
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$$A \rightarrow B \rightarrow C$$
Given $AF = \langle \text{Args}, \text{Def} \rangle$
AFs in Haskell

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```haskell
data DungAF arg = AF [arg] [(arg, arg)]
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Considering arguments as Strings:

```haskell
a, b, c :: AbsArg
a = "A"
b = "B"
c = "C"

AF1 :: DungAF AbsArg
AF1 = AF [a, b, c] [(a, b), (b, c)]
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10/15
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Consider the following diagram:

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A → B → C
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Consider $A \rightarrow B \rightarrow C$

And in Haskell:

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a, b, c :: AbsArg
a = "A"
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AF₁ :: DungAF AbsArg
AF₁ = AF [a, b, c] [(a, b), (b, c)]
```
Conflict-freeness

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$$\text{conflictFree} :: \text{Eq } \text{arg} \Rightarrow \text{DungAF } \text{arg} \rightarrow [\text{arg}] \rightarrow \text{Bool}$$

$$\text{conflictFree} \ (AF \_ \text{def}) \ s$$

$$= \text{null} \ [(a, b) \mid (a, b) \leftarrow \text{def}, a \in s, b \in s]$$
Overview of work done (1)

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- Large parts of Dung’s definitions have been implemented in Haskell,
- Most of these definitions have been formalised in Agda,
- We implemented Carneades in Haskell,
- Provided a sketch of how to do a translation from Carneades to Dung in Haskell and which properties one would want to prove.
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Formalisation in Agda, the initial work on the translation and all Haskell code is either discussed or linked to in the paper.
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  • A better understanding of the meaning of some of the complexer argumentation models.
Future work

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• **Further formalisation** of Dung’s definitions and theorems:
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- **Implementation and formalisation** of the translation from Carneades to Dung.
- **Connect the implementation** of Dung’s AFs to an **optimised implementation** using ASP or SAT.