Practical and epistemic reasoning in argumentation dialogues: from theory to practice

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Argumentation

- Argumentation logics
  (semantics, structure, values/preferences, . . .)
- Argumentation dialogues
  (persuasion, negotiation, deliberation, . . .)

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Why argue?

Agent that argue are supposed to be

- more efficient
- more effective

But are they, in practise?

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Experimental validation

Validation through:

- Generating scenarios
- Running agents
- Measure the dialogues
- Analyse

Deliberation!

- Multi-agent
- Shared and personal goals
- Epistemic and practical reasoning

Practical reasoning

Epistemic arguments

- About the truth status of beliefs
- Sceptical reasoning

Practical arguments

- About (proposals to do some) action
- Credulous reasoning (Prakken, 2006)

Argument scheme

Argument scheme for practical reasoning (Atkinson, 2005)

In the current circumstances R
Action A should be performed
To bring about new circumstances S
Which will realise goal G
And promote value V

An example

Epistemic reasoning

- ‘steaks made from wagyu cattle are wagyu steaks’
- ‘steaks from wagyu beef are the best steaks’

Practical reasoning

- ‘to enjoy our dinner we should go to the bistro, because they serve the best steaks’

Existing approaches

Atkinson (2005)

- AS encoded as $R \xrightarrow{A} S \models G \uparrow v$
- Strict protocol with pre- and post-conditions

Rahwan and Amgoud (2007)

- Distinct belief and desire undercut
- Desire and consequence conflicts using custom semantics

Existing approaches (cont.)

Black (2011)

- AS encoded as single-inference abstract argument
- Asserted arguments are evaluated as argumentation theory

Bench-Capon and Prakken (2006); Prakken (2006)

- Accrual of structured arguments
- Desire modality in logical language
- E-p-semantics

Desirable properties

- Embedded in the logical language
- Playing nice with existing semantics
- Structured argumentation

Desire modality

Following Bench-Capon and Prakken (2006); Prakken (2006):

- backwards application of rules

$$\dfrac{\dfrac{D\text{enjoyDinner} \qquad \text{bestSteak} \Rightarrow \text{enjoyDinner}}{D\text{bestSteak}} \qquad \text{goToBistro} \Rightarrow \text{bestSteak}}{D\text{goToBistro}}$$

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Attack between practical arguments

$$\dfrac{\dfrac{D\text{enjoyDinner} \qquad \text{bestSteak} \Rightarrow \text{enjoyDinner}}{D\text{bestSteak}} \qquad \text{goToBistro} \Rightarrow \text{bestSteak}}{D\text{goToBistro}}$$

is alternative-attacked by

$$\dfrac{D\text{enjoyDinner} \qquad \text{bestSteak} \Rightarrow \text{enjoyDinner}}{D\text{bestSteak}}$$

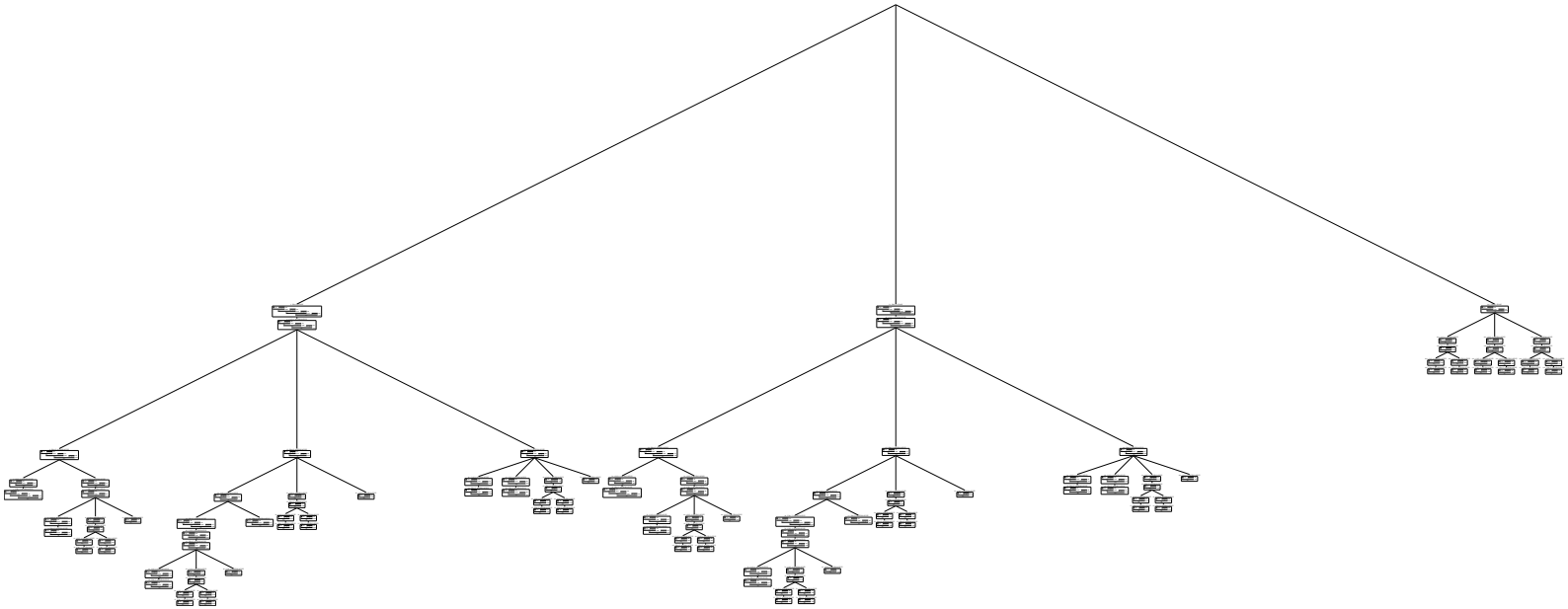
Explosion of arguments

Now consider a (still small) knowledge base:

- Goals: Dg
- Action: o
- Rules: $o \Rightarrow p; p \Rightarrow q; q \Rightarrow r; r \Rightarrow g$
- $q \Rightarrow g; p \Rightarrow g; o \Rightarrow g$
- $o \Rightarrow q; o \Rightarrow r$

Explosion of arguments and argument attacks!

Explosion of arguments



Cause: alternatives

- How realistic is this?

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Generation deliberation scenarios

Deliberation scenario characteristics:

- Multi-agent
- Shared and personal knowledge
- Shared and personal goals
- Various possible actions

Knowledge assignment

Connect an assigned goal g to some possible action a:

$$\mathrm{o} \Rightarrow \mathrm{p}; \mathrm{p} \Rightarrow \mathrm{q}; \mathrm{q} \Rightarrow \mathrm{r}; \mathrm{r} \Rightarrow \mathrm{g}$$

Rule chaining (Kok et al., 2011)

- Repeat for actions and personal and mutual goals

Result: argument explosion...

Alternative encoding

Allow goals and actions in the topic language

$$\dfrac{\dfrac{\text{enjoyDinner} \qquad \text{enjoyDinner} \Rightarrow \text{bestSteak}}{\text{bestSteak}} \qquad \text{bestSteak} \Rightarrow \text{goToBistro}}{\text{goToBistro}}$$

Upside:

- normal models for structured argumentation apply
- no explosion of (attack amongst) arguments

Downside:

- action as conclusion instead of premise
- no intertwined credulous & epistemic reasoning

An experiment with deliberation

Full model for experimentation

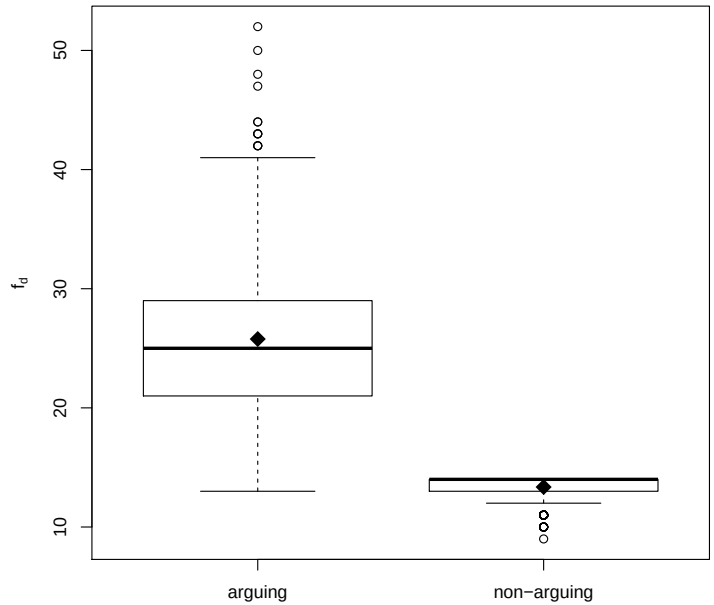
- Formal model for deliberation dialogues
- Generating scenarios through rule chaining
- Simple arguing and non-arguing strategies

Software simulation

- Play many dialogues
- Measure efficiency and effectiveness

(See http://aspic.cossac.org/ for South and Vreeswijk's ASPIC Java Inference Components)

Dialogue efficiency



Arguing vs. non-arguing efficiency in number of moves (Kok et al., 2012)

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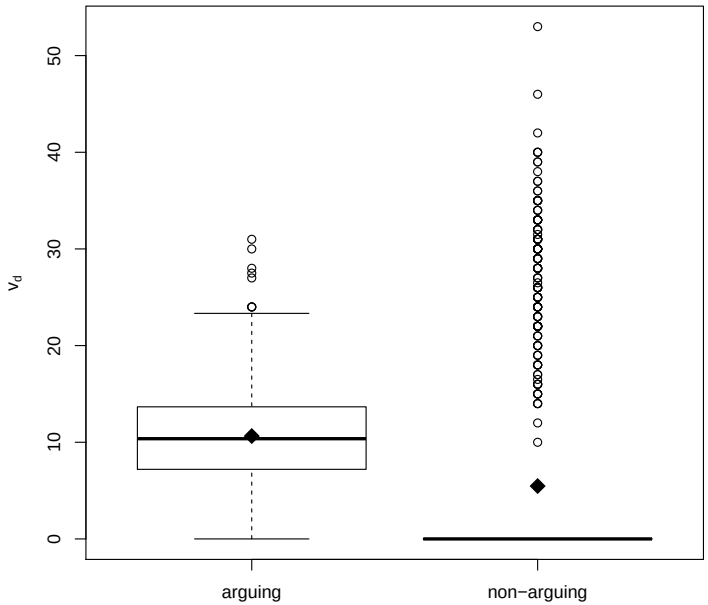
Dialogue effectiveness



Arguing vs. non-arguing effectiveness as combined utility (Kok et al., 2012)

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Wrap up

Conclusions

- Formal models for practical reasoning not quite ready
- But argumentation has great potential benefits

I'll be...

- At AAMAS/ArgMAS
- Finishing up this work in my thesis

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