ESSENCE 2014 : Argumentation-Based Models of Agent Reasoning and Communication

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Outline

- Logic and Argumentation

  - Dung’s Theory of Argumentation
  - The Added Value of Argumentation
  - Rationality Postulates for Logic-based Argumentation

- Argumentation Based Dialogue

  - Argument Game Proof Theories
  - Generalisation to Dialogue
  - Applications

Argument Game Proof Theories

Decision Questions for Dung Frameworks

- We have seen how given an *AF* ($\mathcal{A}rgs$,$\mathcal{A}tt$), we can define when a ***given*** set E $\subseteq \mathcal{A}rg$ is an extension under the admissible, grounded, preferred ... semantics

- But we would like constructive procedures for answering decision questions such as

  - Does an extension exist ?
  - Give all extensions ?

  :

  - Is argument X contained in an extension ?
  - Is argument X contained in all extensions ?

  :

Decision Questions for Dung Frameworks

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  :

  - Is argument X contained in an extension ?

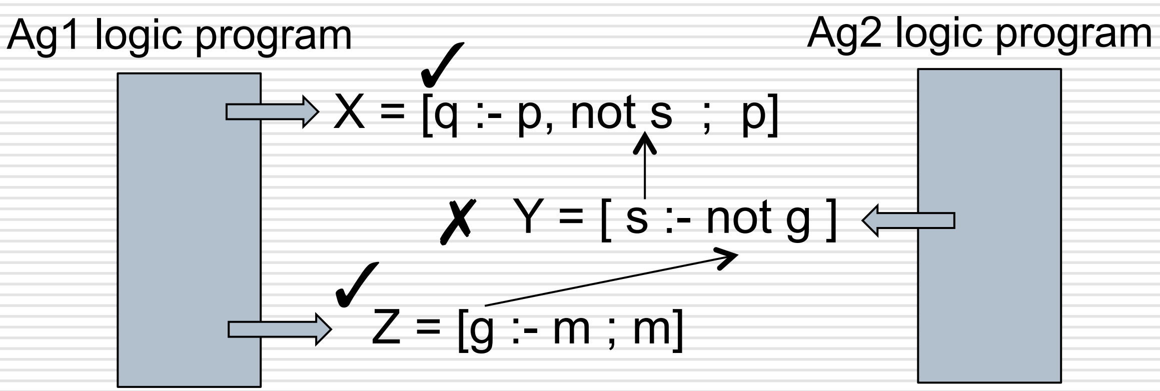
  - Is argument X contained in all extensions ?

- Argument game proof theories* for deciding whether X in a preferred / the grounded extension

* S. Modgil and M.Caminada. Proof theories and algorithms for abstract argumentation frameworks. In : *Argumentation in Artificial Intelligence* (eds. I.Rahwan and G.Simari) 105-129, Springer,2009

The Added Value (1)

- Basis for defining procedures for distributed non-monotonic reasoning based on simple, intuitive principle of reinstatement



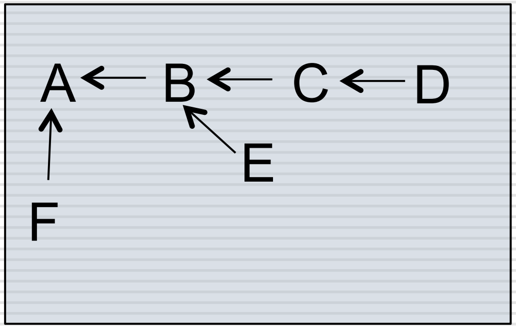
- Argument Game proof theories ➔ basis for dialogues in which agents exchange arguments to persuade, deliberate over a course of action, negotiate …
- Evaluation of exchanged arguments decides dialogue outcome

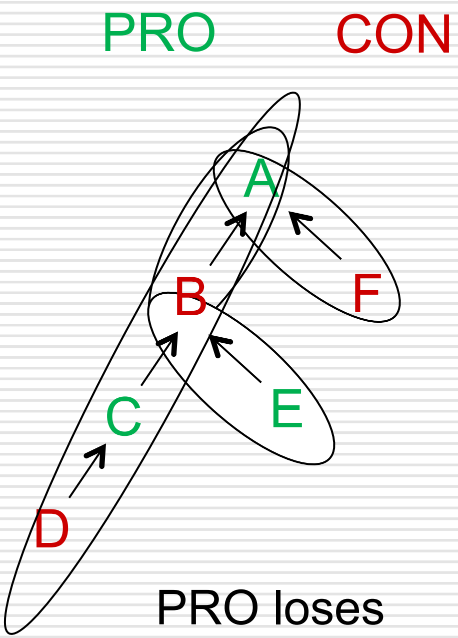
Argument games – the basic idea

- Suppose you want to know whether <u>X is in an extension of an AF</u>.
- Two player game in which the *proponent* (PRO) *moves* X, and *opponent* (OPP) then moves an argument Y that attacks X (remember that these games are played by reference to an ***existing*** AF of arguments and attacks)
- PRO can then move a counter-attack Z to Y (ie., a Z that defends X)
- OPP then counter-attacks Z, and so on ....
- If at any stage a player is stuck and cannot move a counter-attack, she can backtrack to a previous move of her adversary, and try an alternative counter-attack
- If PRO *successfully* counter-attacks (in the sense that PRO is not in turn counter-attacked by OPP) every move by OPP, then PRO wins, else loses.

Argument games – the basic idea

AF =





Note that we have a game tree with three ***disputes***

Argument game rules

- But this is not the whole story. Depending on the semantics, the rules on what moves can be made (are *legal*) vary

- In the *grounded game* (PRO tries to show that X is in the grounded extension) ***PRO cannot repeat an argument in the same dispute***

- In the *preferred game* (PRO tries to show that X is in a preferred extension) ***OPP cannot repeat an argument in the same dispute***

- Before explaining this symmetric difference in the rules of the game, a digression .....

Argument game rules

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Admissible Game = Preferred Game

- Actually the argument game for showing membership of a preferred extension is an argument game for showing membership of an admissible extension

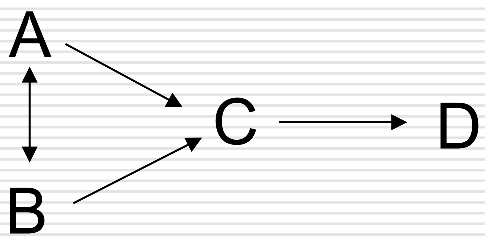
- Because every admissible set of arguments is a subset of a preferred extension

- This follows from a key results for Dung frameworks, called the ***Fundamental Lemma*** :

  If X and Y are acceptable w.r.t. an admissible extension E, then E ∪ X is admissible, and Y is acceptable w.r.t. E ∪ X

Explaining the rules of the grounded game

- Recall the AF :



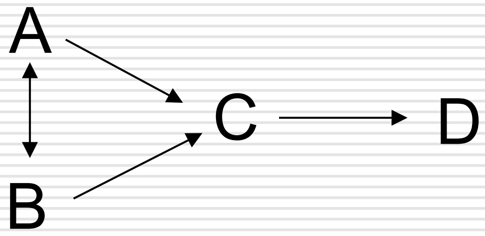
E1 = {A,D} and E2 = {B,D} are preferred extensions

$\emptyset$ is grounded extension

- In each preferred extension there is an argument *that defends itself* against an attack – A in E1 and B in E2
- The grounded semantics places a higher burden of proof – one cannot in defending an argument X, either directly ***or indirectly*** self-defend with X. In an argument game this amounts to PRO not repeating X in a dispute.

Explaining the rules of the preferred game

- Recall the AF :



E1 = {A,D} and E2 = {B,D} are preferred extensions

∅ is grounded extension

- Why then the rule preventing OPP repeating in a preferred game ?

- Because : 1) otherwise the game may go on forever ; 2) PRO has already defended himself against OPP's repeated argument

Explaining the rules of the preferred game

AF =

$A \leftrightarrow B$

Is A in a preferred extension ?

PRO OPP

$$\begin{array}{c} A \\ \uparrow \\ B \\ \uparrow \\ A \\ \uparrow \\ B \\ \uparrow \end{array}$$

Explaining the rules of the preferred game

AF =

$A \leftrightarrow B$

Is A in a preferred extension ?

PRO OPP

A

↑

B

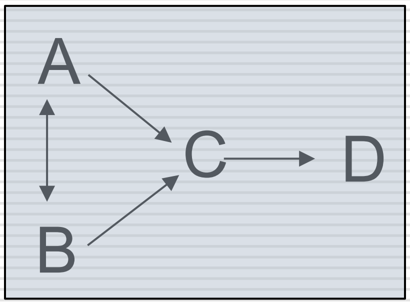
↑

A

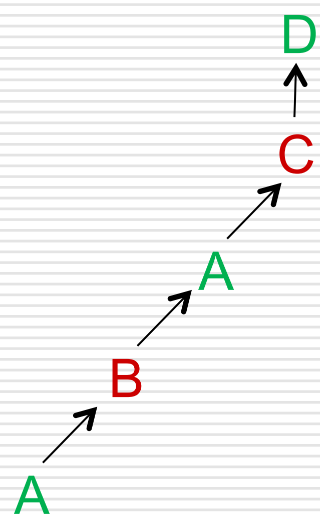
- PRO wins – there is an preferred extension {A} that contains A

Example – is D in a preferred extension ?

AF =



PRO OPP



PRO wins

Example – is D in a preferred extension ?

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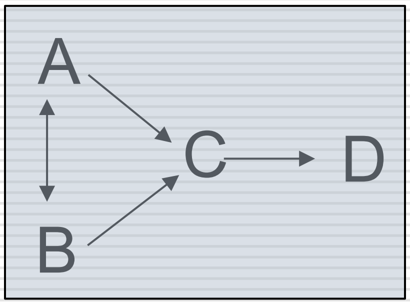
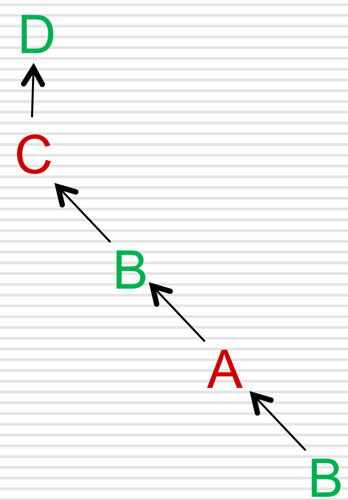


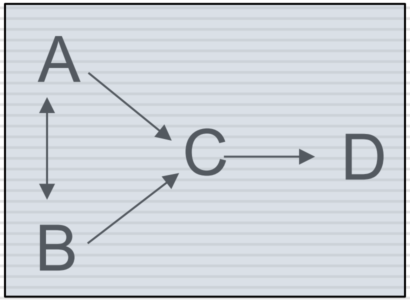
PRO OPP



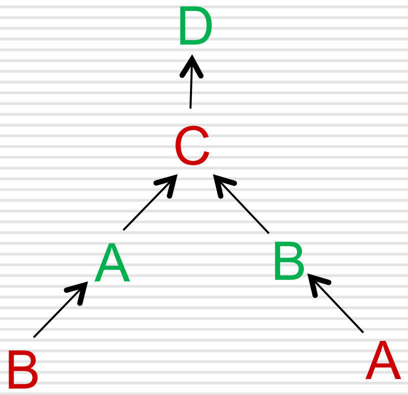
PRO wins

Example – is D in the grounded extension ?

AF =



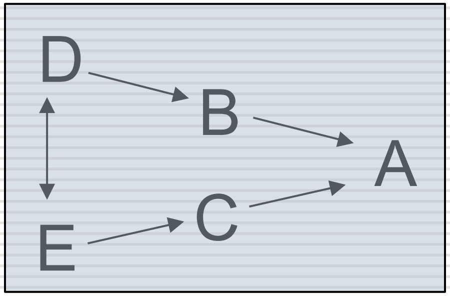
PRO OPP

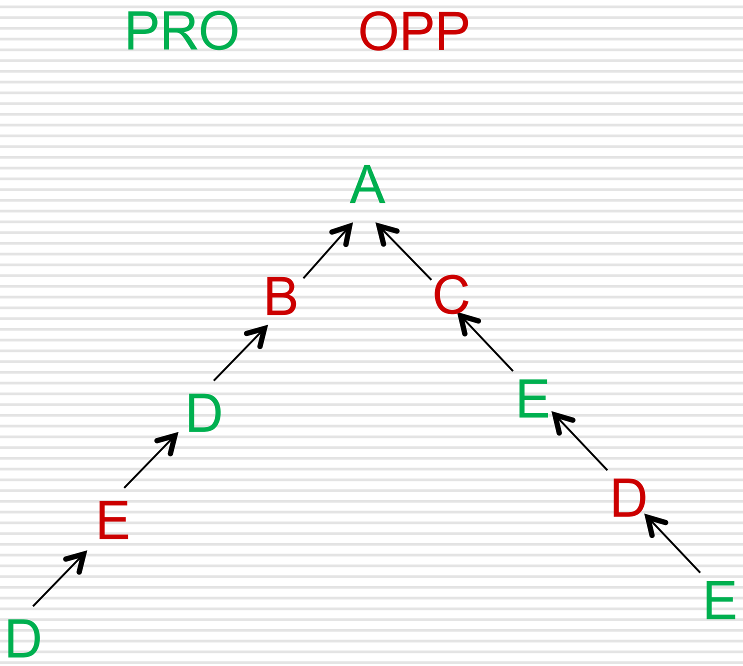


PRO loses

Another Example – Is A in a preferred extension ?

AF =





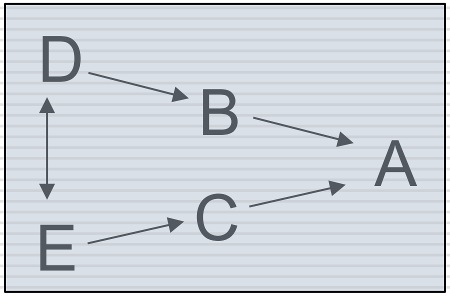
Should PRO win ?

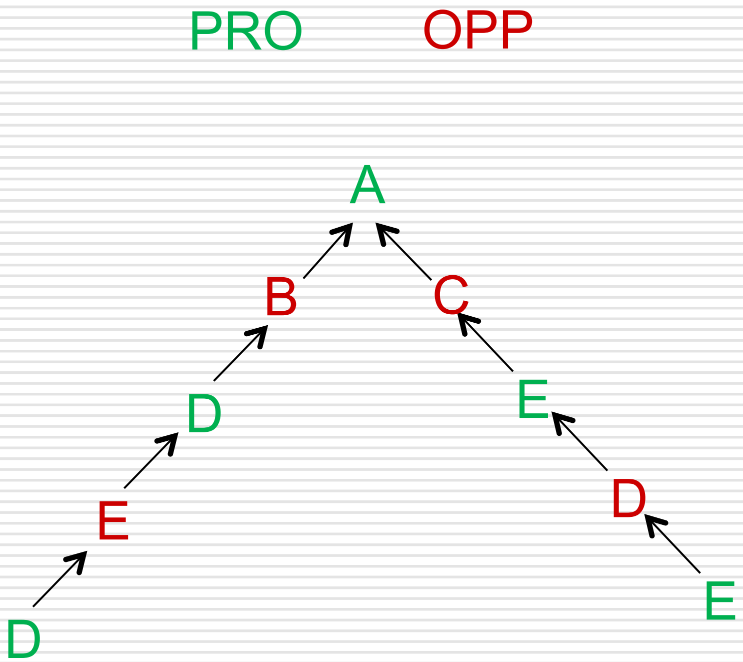
Argument games : moves by PRO

- In the grounded game, if PRO wins, then the arguments moved by PRO constitute a subset of the grounded extension
- In the preferred game, if PRO wins, then the arguments moved by PRO constitute a subset of a preferred extension

Another Example – Is A in a preferred extension ?

AF =





Should PRO win ?

Defining the Grounded Game

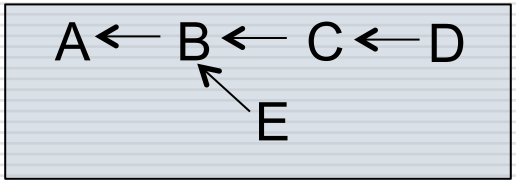
- X is in the grounded extension of ($\mathcal{A}rgs$,$\mathcal{A}tt$) iff

  There exists a game tree T with root X such that:

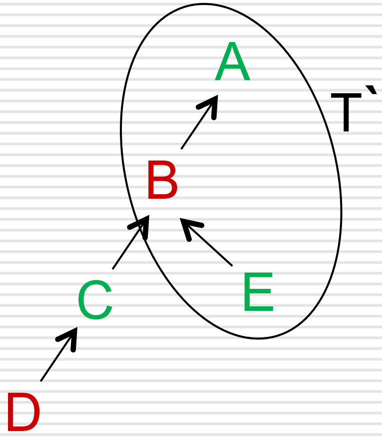
  1) If PRO moves Y in a dispute d (path in the tree) and (Z,Y) $\in \mathcal{A}tt$ then OPP moves Z against Y
  2) If OPP moves Y in a dispute d and (Z,Y) $\in \mathcal{A}tt$ then PRO moves Z against Y only if Z does not already occur in d
  3) There is a subtree T\` of T such that each OPP argument is attacked by a PRO argument (T\` is a called a *winning strategy*)

Argument games – winning strategies

AF =



T



PRO wins

Even though not every dispute in T is won by PRO there is a winning strategy T`

Defining the Preferred Game

- X is in a preferred extension of ($\mathcal{A}rgs$,$\mathcal{A}tt$) iff

  There exists a game tree T with root X such that:

  1) If PRO moves Y in a dispute d (path in the tree) and (Z,Y) $\in \mathcal{A}tt$ then OPP moves Z against Y only if Z does not already occur in d
  2) If OPP moves Y in a dispute d and (Z,Y) $\in \mathcal{A}tt$ then PRO moves Z against Y
  3) There is a subtree T` of T such that each OPP argument is attacked by a PRO argument (T` is a called a *winning strategy*) and the arguments moved by PRO in T` do not attack each other

More on Games

- Note that one can gain efficiency with extra rules on the legality of moves, e.g. prohibiting PRO from moving arguments that attack, or are attacked by arguments PRO has already moved

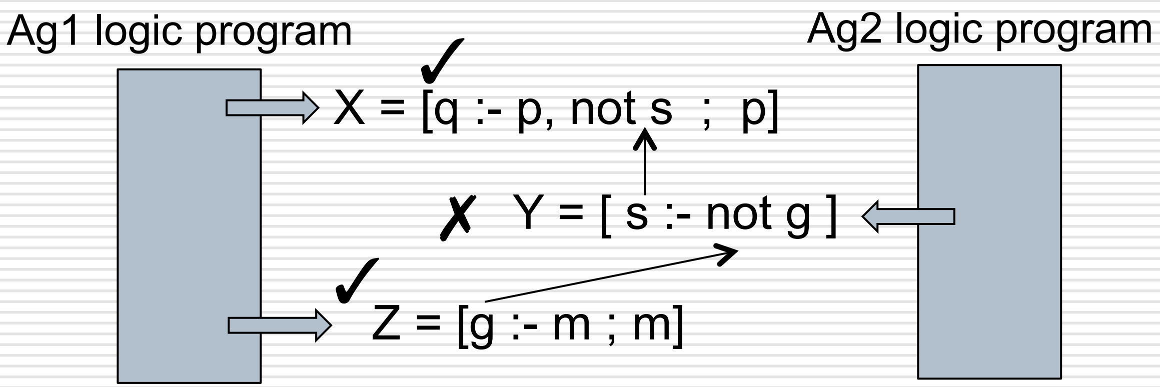
- Further reading:

- S. Modgil and M.Caminada. Proof theories and algorithms for abstract argumentation frameworks. In : *Argumentation in Artificial Intelligence* (eds. I.Rahwan and G.Simari) 105-129, Springer,2009

- Vreeswijk, G.A.W. An algorithm to compute minimally grounded and admissible defence sets in argument systems. In P.E. Dunne & T.J.M. Bench-Capon (Eds.), *Proc. of the First Int. Conference on Computational Models of Argument (COMMA06)*,109-129,. IOS Press, 2006.

- C. Cayrol, S. Doutre, and J. Mengin. On Decision Problems related to the preferred semantics for argumentation frameworks. Journal of Logic and Computation, 13(3):377–403, 2003

From Argument Games to Dialogue



- Argument Game proof theories ➔ basis for dialogues in which agents exchange arguments to persuade, deliberate over a course of action, negotiate …
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Argumentation-based Dialogue

From Argument Games to Dialogue

- Argument Game proof theories ➔ generalise to dialogues :

1) The moves are ***not*** defined w.r.t. an existing AF. Rather, each agent builds arguments from its own knowledge base and these then define an argument framework

2) Ag 1 successfully persuades Ag 2 that α is true, if Ag1's initial argument claiming α is justified (under some semantics) in the ***framework that is incre****mentally* built during the course of the dialogue

3) But dialogues do not just involve moving arguments as 'locutions'. An agent might just *claim* that α is the case, or query *why* α, or *retract* or *concede* α or *argue* that α since β and β $\rightarrow$ α ...

From Argument Games to Dialogue

Paul(1) : My car is very safe. (making a claim)

Olga(1) : Why is your car safe? (asking to justify claim with an argument)

Paul(2) : Since it has an airbag. (offering argument for claim)

Olga(2) : That is true. (conceding a premise) but I disagree that this makes your car safe: the newspapers recently reported on airbags expanding without cause. (stating a counterargument)

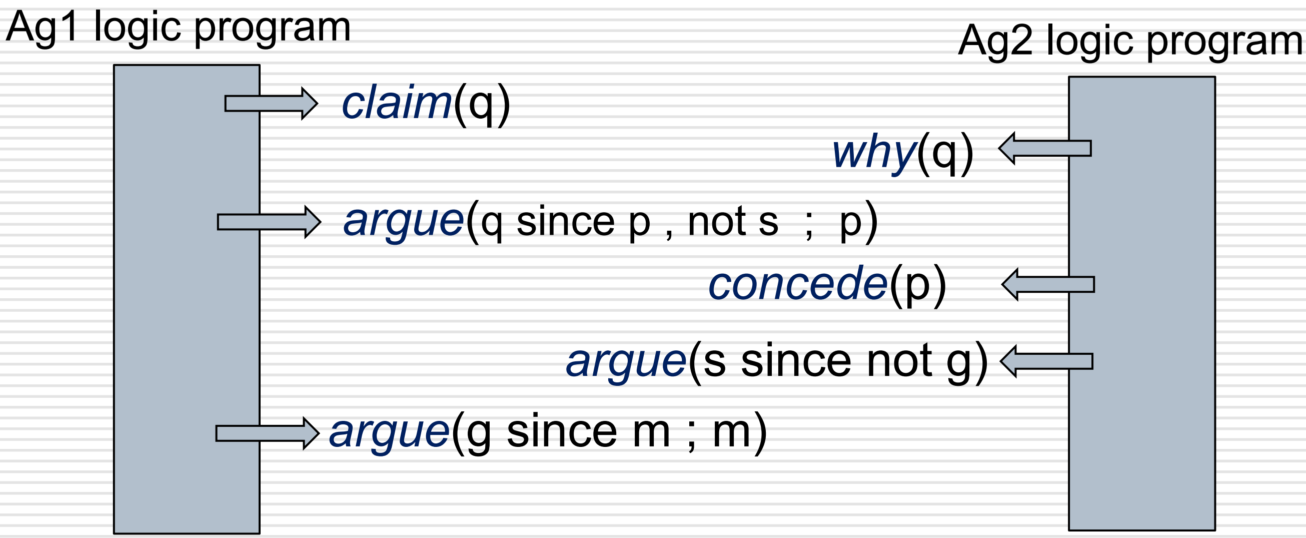
Paul(3): Yes, that is what the newspapers say (conceding a claim) but that does not prove anything, since newspaper reports are very unreliable sources of technological information. (attacking a counterargument)

Olga(3):Still your car is not safe, since its maximum speed is very high. (alternative counterargument)

From Argument Games to Dialogue

- Argument Game proof theories ➔ generalise to dialogues :

  4) Communication language defines what are legal locutions. Locutions consist of a speech act and content (e.g., *argue*(α since β and $\beta \rightarrow \alpha$), *claim*("My car is safe"), *why*(α) e.t.c)



Dialogue Protocols

- Argument Game proof theories ➔ generalise to dialogues :

  5) As well as defining a communication language we require protocols that specify rules governing the reply structure of a dialogue. These generalise the rules we have seen for argument games (the non-repetition rules on players and the rule that each argument must attack the argument it replies to)

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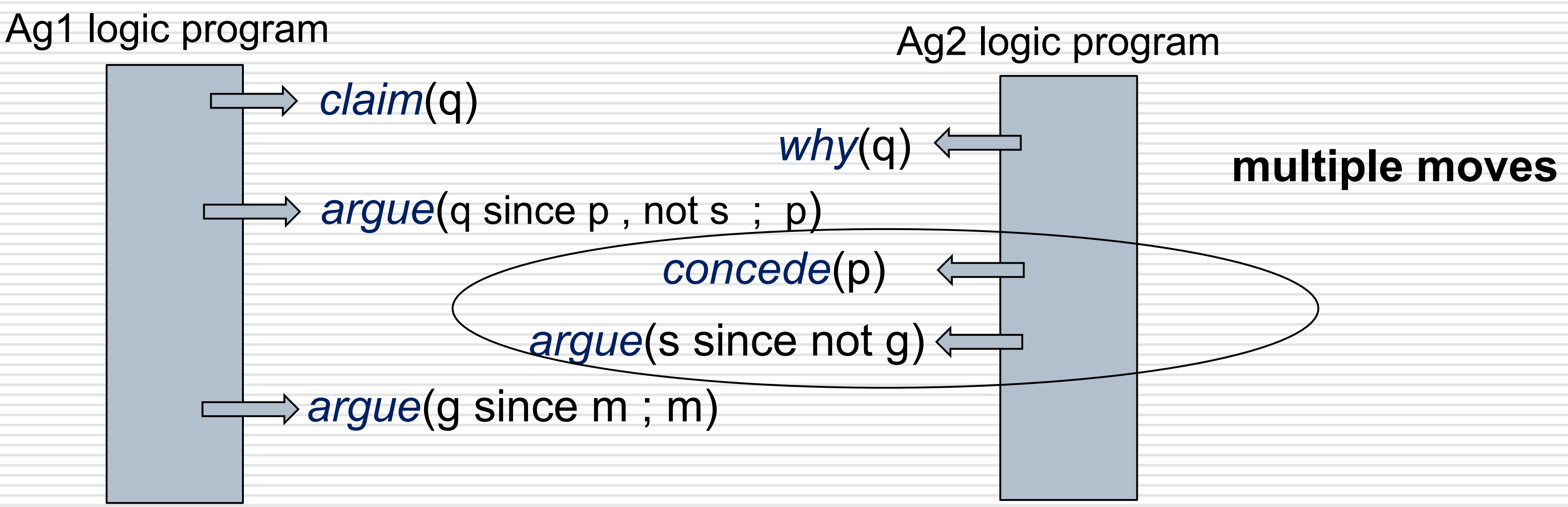
  - single or multi-move protocols (whether a player can make only one or many moves at a time)

From Argument Games to Dialogue



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  - single or multi-move protocols (whether a player can make only one or many moves at a time)
  - unique or multi-reply protocols (whether a player can try alternative replies to any given move) i.e, is backtracking allowed ?

From Argument Games to Dialogue

Paul(1) : My car is very safe. (making a claim)

Olga(1) : Why is your car safe? (asking grounds for a claim)

Paul(2) : Since it has an airbag. (offering grounds for a claim)

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Olga(3) is an alternative (backtracking) reply to Paul(1)

Dialogue Protocols

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  - general common-sense protocol rules such as one cannot reply to one’s own move, and if you backtrack then backtrack with a different reply
  - legal reply rules specific to the communication language e.g.

Dialogue Protocols

- Legal replies to a move *claim*(α) are *why*(α), *concede*(α), *claim*($\neg\alpha$), *argue*($\neg\alpha$ since .....). Obviously *retract*(α) is not a legal reply.
- Legal replies to a move *why*(α) are *retract*(α), *argue*(α since .....).

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- Legal replies to a move *why*(α) are *retract*(α), *argue*(α since .....).

- Other rules may refer to

  a) previous locutions, e.g. if you concede α then you cannot later query why α , if you claim α then you cannot later claim $\neg\alpha$

  b) the contents of the participating agents' knowledge bases, e.g., Ag1 can only move *claim*(α) if Ag1 can construct an argument for α from its own knowledge base (more controversial – why ?)

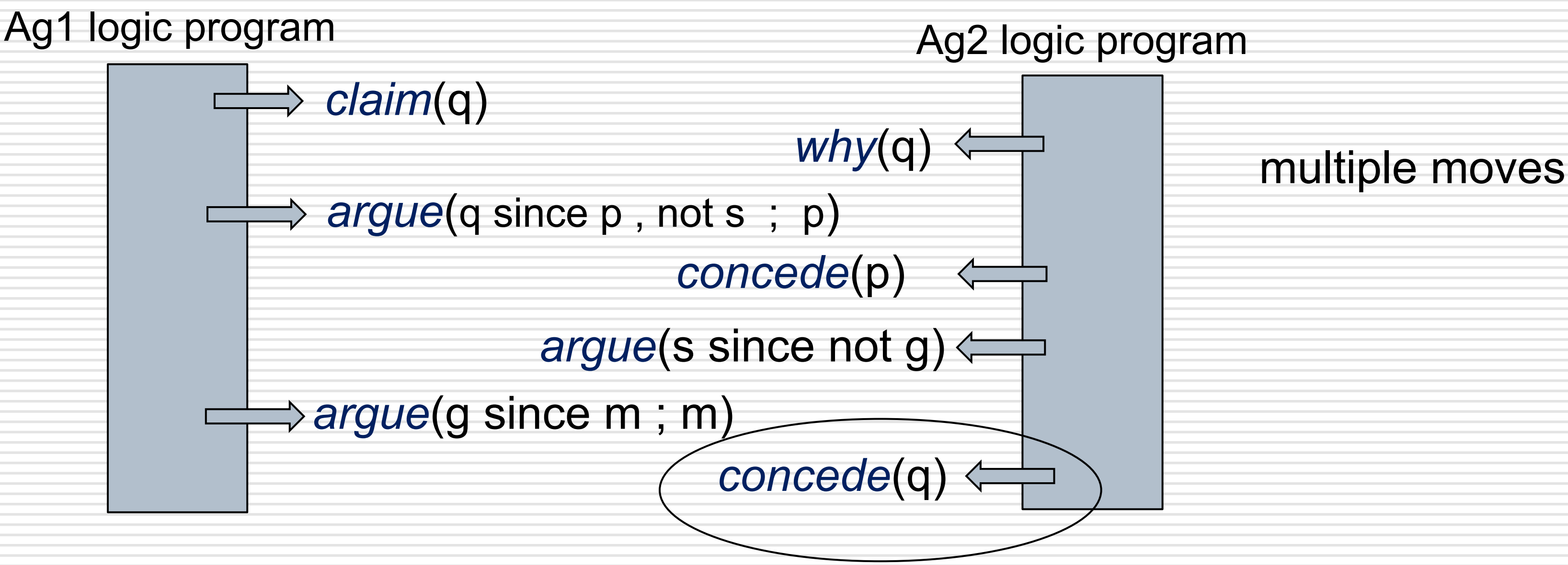
Components of Frameworks for Dialogues

- So far we have seen how a framework for dialogue can be understood as generalising argument games to include
  a) A communication language enabling moves that are not just arguments, but locutions that allow one to assert claims as well as arguments, challenge, concede, retract etc
  b) A protocol that specifies the rules of the dialogue's reply structure

- We have seen how the ***outcome*** (whether PRO wins or not) ***of an argument game*** is determined (the existence of a sub-tree that is a winning strategy)

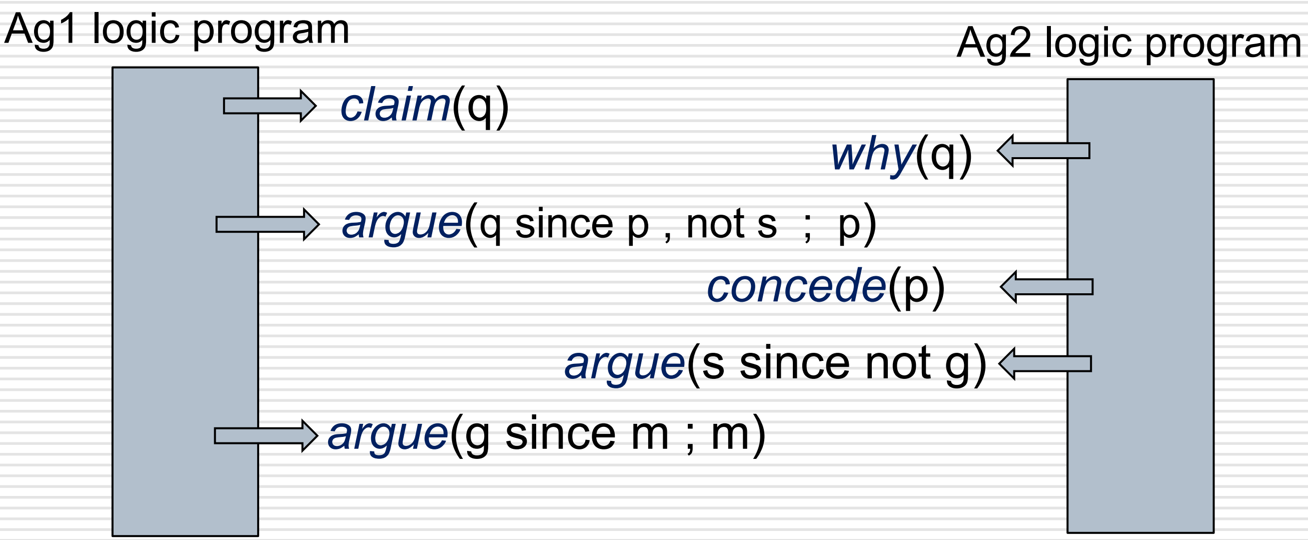
- How are the ***outcomes of dialogues*** determined ?

Dialogue Outcomes



- Some approaches require that the initial claim (the topic of the dialogue) is explicitly conceded, or based on who made the last move ...

Dialogue Outcomes



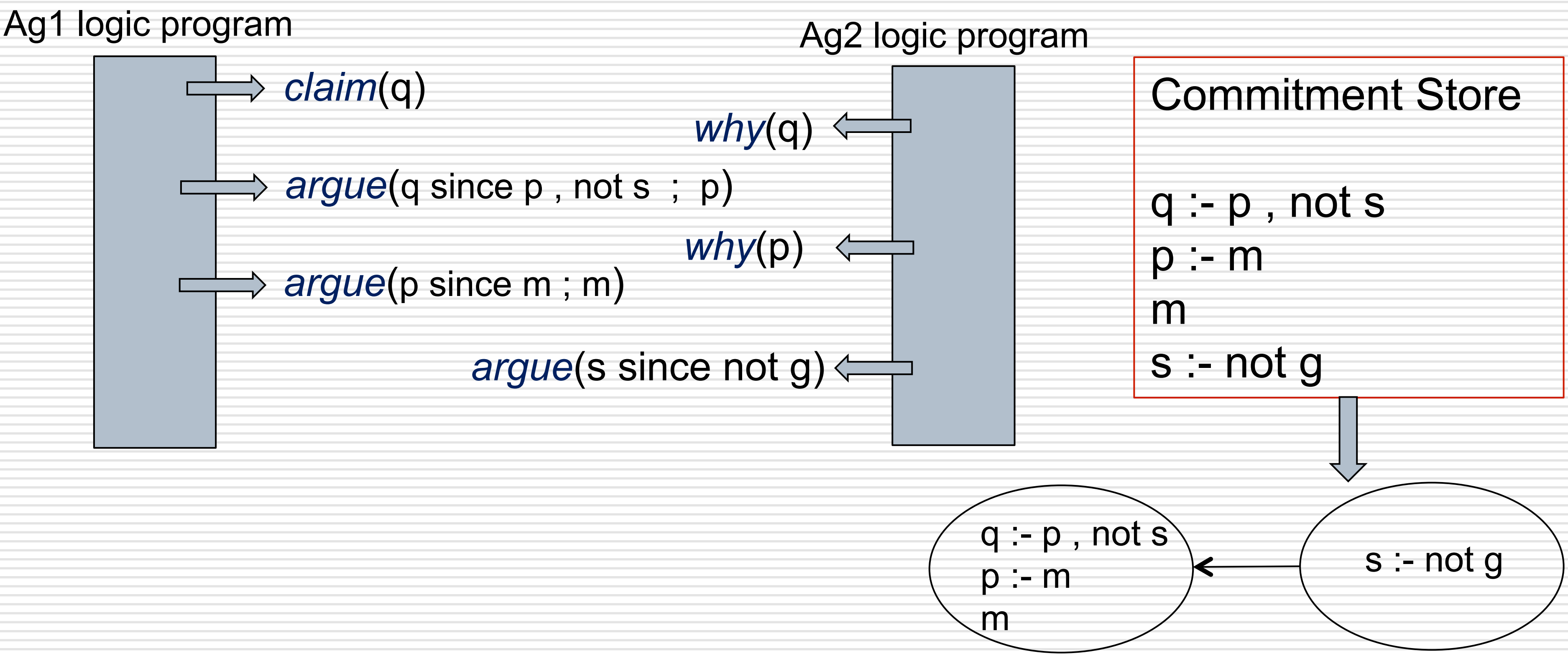
- But a more principled approach (why more principled ?) is to

  a) record all the asserted contents of locutions in a <u>commitment store</u>

  b) instantiate an AF from the commitment store

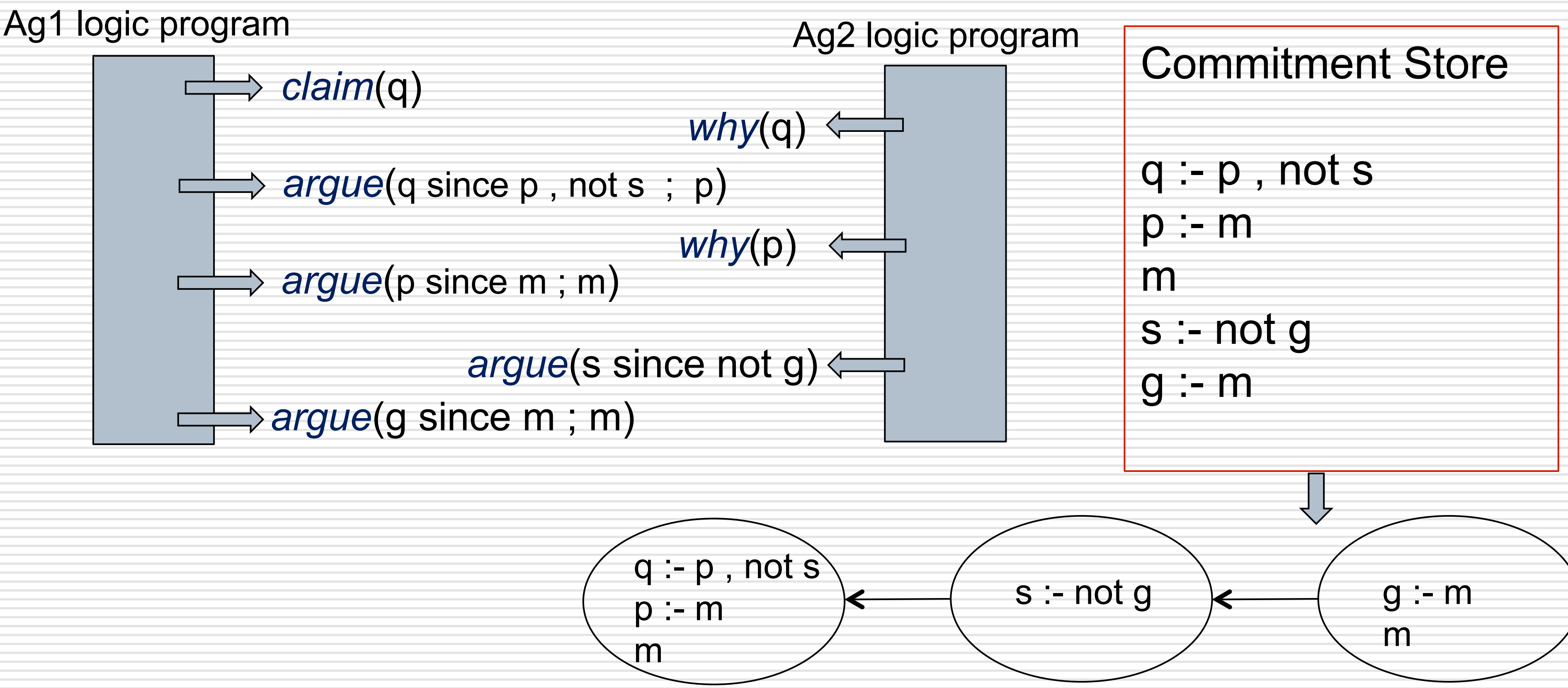
  c) evaluate the justified arguments which in turn determines the outcome of a dialogue at any stage in the dialogue

Dialogue Outcomes



- Argument claiming q is not justified therefore Ag2 is currently winning

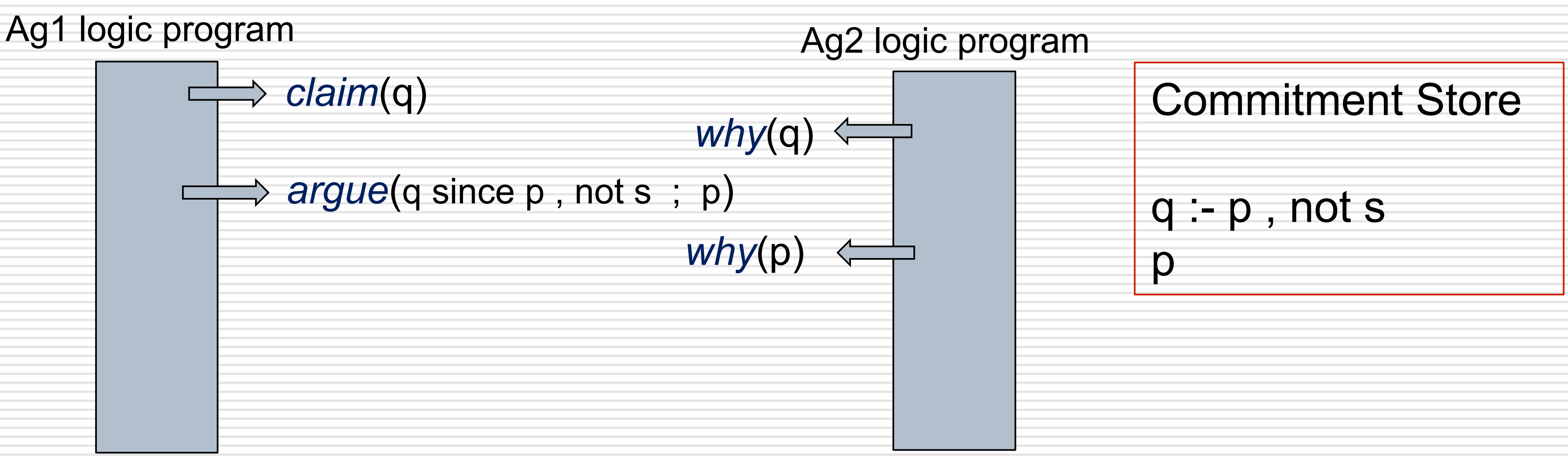
Dialogue Outcomes



- Argument claiming q **is** now justified therefore Ag1 is currently winning

Commitment rules

- We now need to specify the effects of locutions on the commitment store, e.g.,



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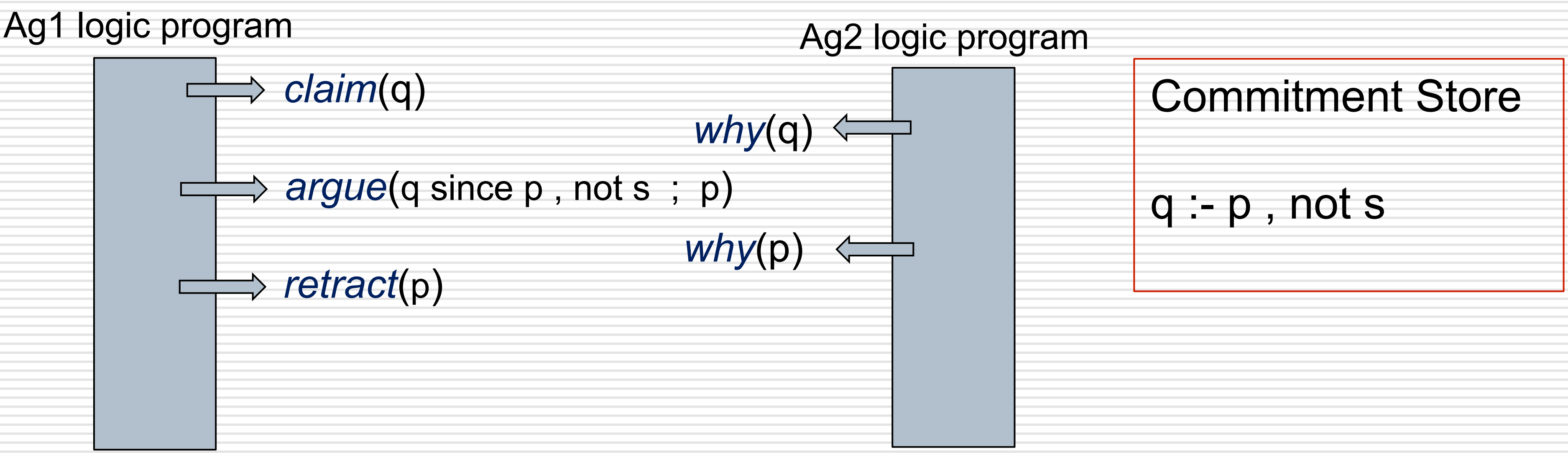
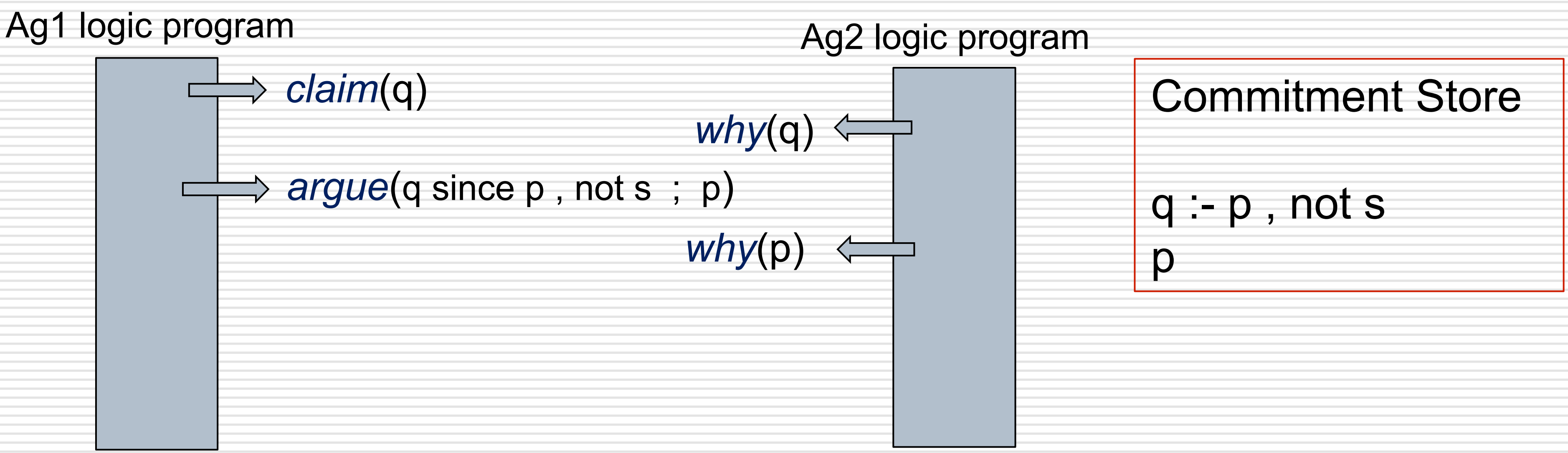
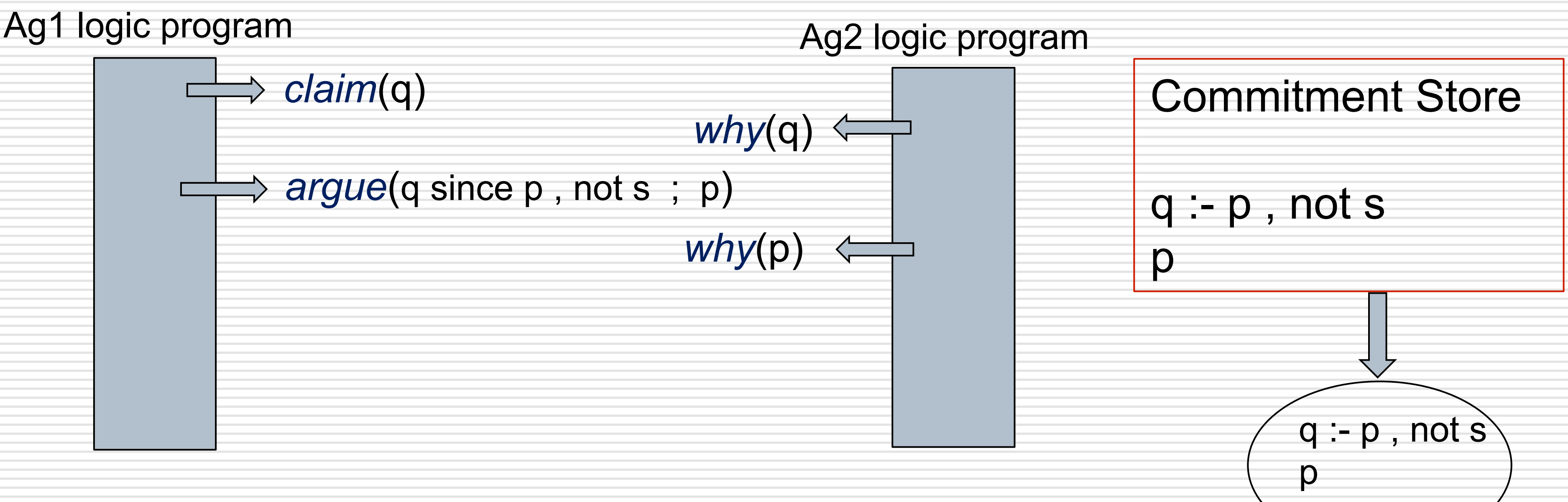


The dialectical role of non-assertional locutions

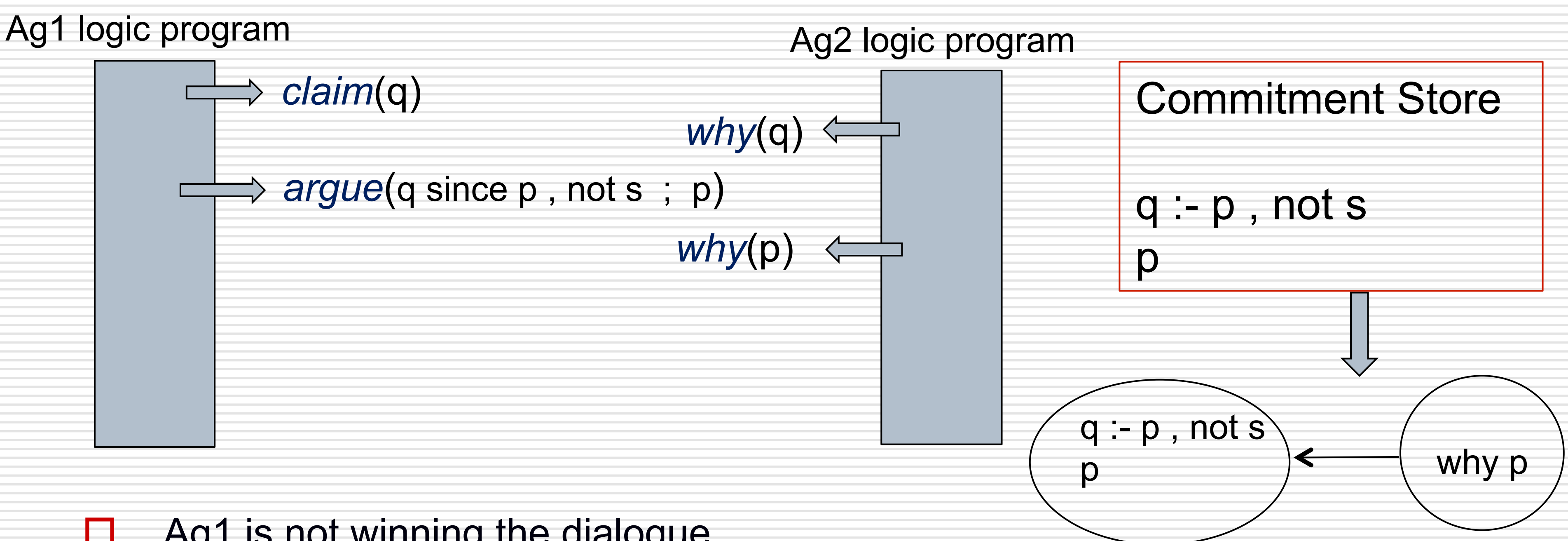


The dialectical role of non-assertional locutions



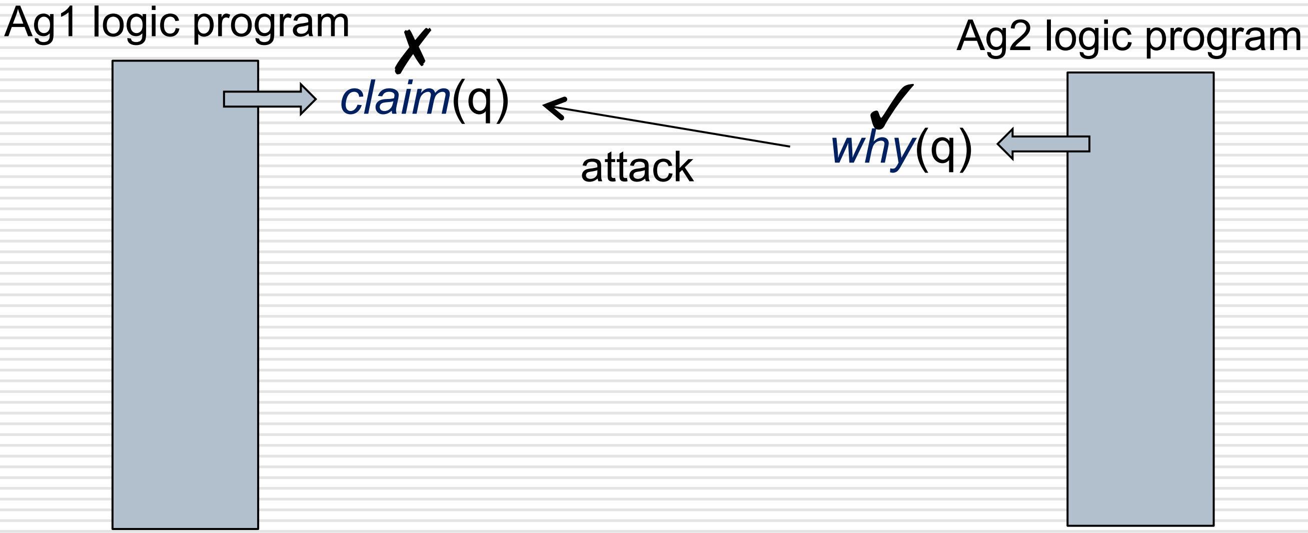
- Can Ag1 be said to have persuaded Ag2 that q is true ?

The dialectical role of non-assertional locutions



- Ag1 is not winning the dialogue

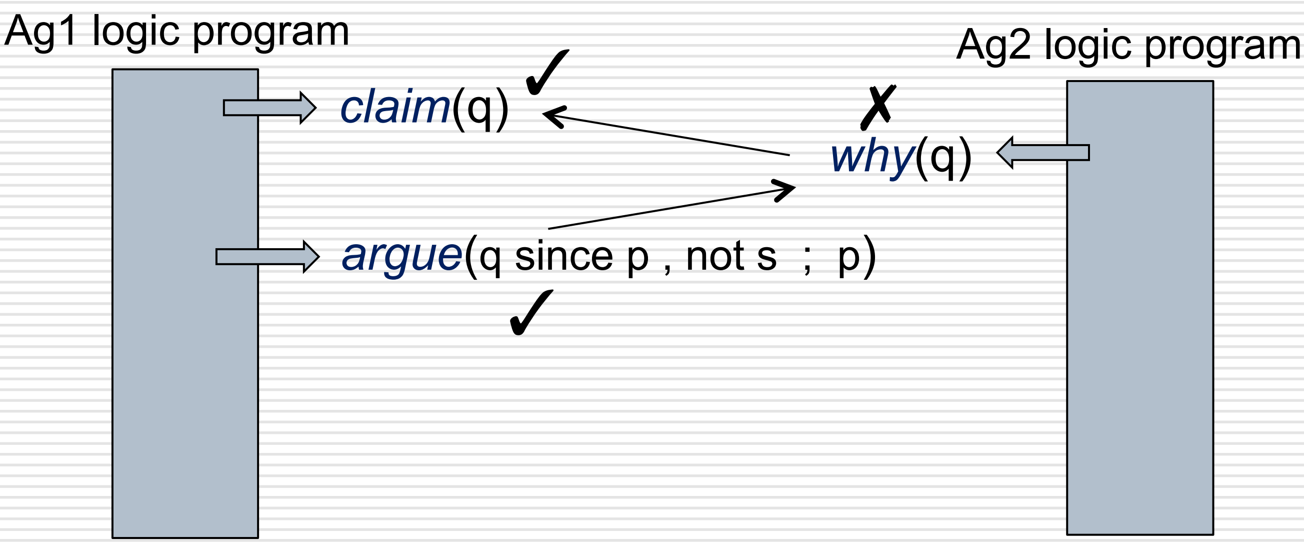
Dialectical graphs of locutions



Commitment Store
q

- Ag1 is **not** winning the dialogue

Dialectical graphs of locutions

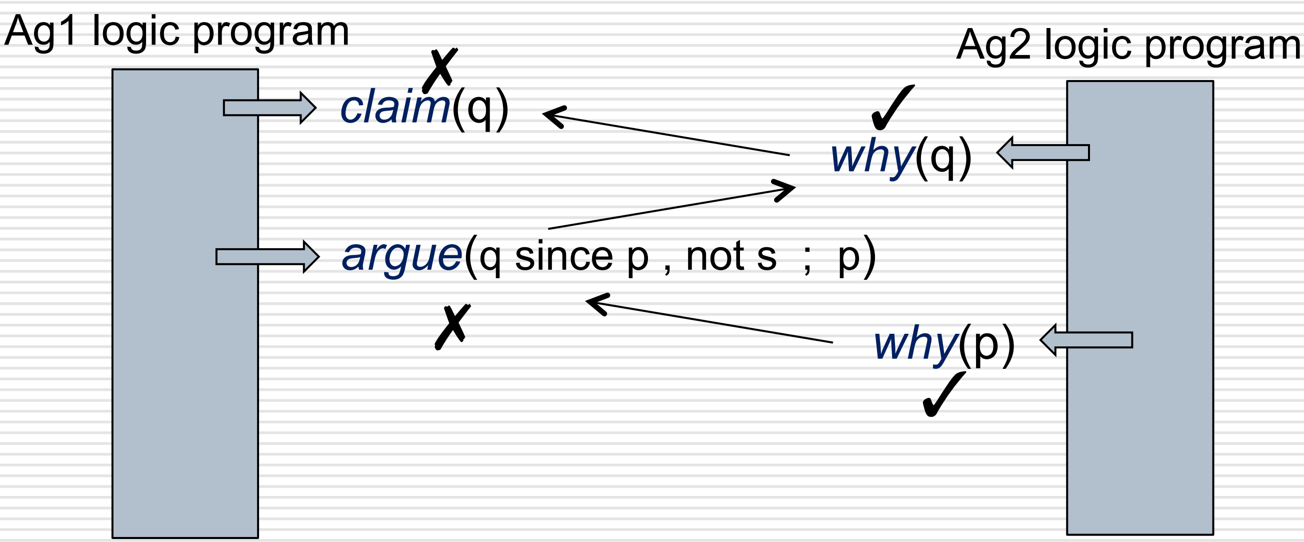


Commitment Store

q :- p , not s
p

- Ag1 **is** winning the dialogue

Dialectical graphs of locutions



Commitment Store

q :- p , not s
p

- Ag1 is **not** winning the dialogue

Dialectical Feedback

- Evaluation of arguments in AF instantiated by knowledge in commitment store can provide rational dialectical feedback to participating agents

  - who is currently winning
  - you should move Z
  - the relevant moves to reply to in order to win the dialogue

Dialectical Feedback

- Evaluation of arguments in AF instantiated by knowledge in commitment store can provide dialectical feedback to participating agents

- who is currently winning

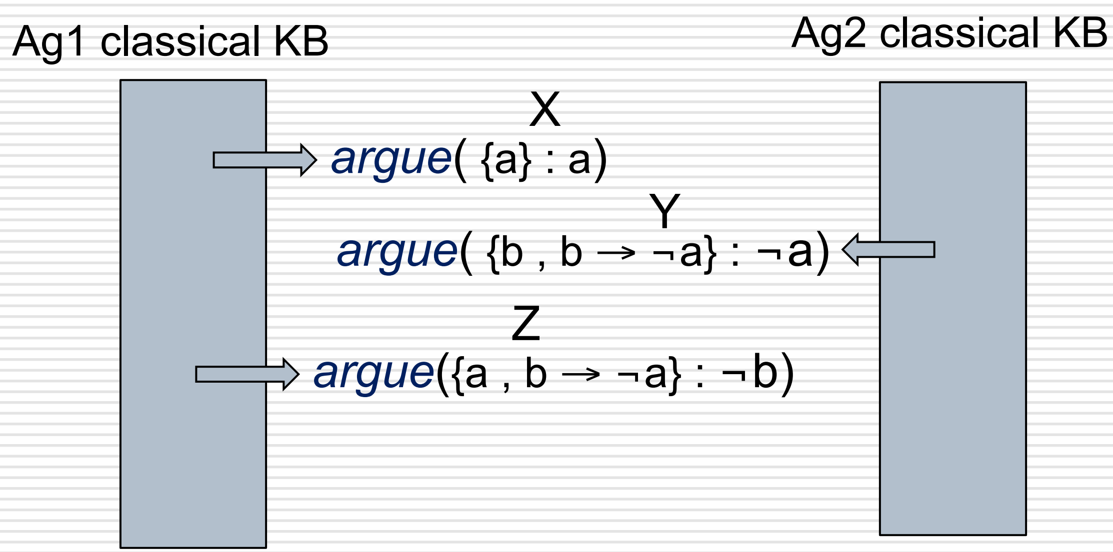
- you should move Z

from commitments

a and b $\rightarrow \neg a$,

Ag1 can reply to (attack) Y with

$Z = \{a , b \rightarrow \neg a\} : \neg b$



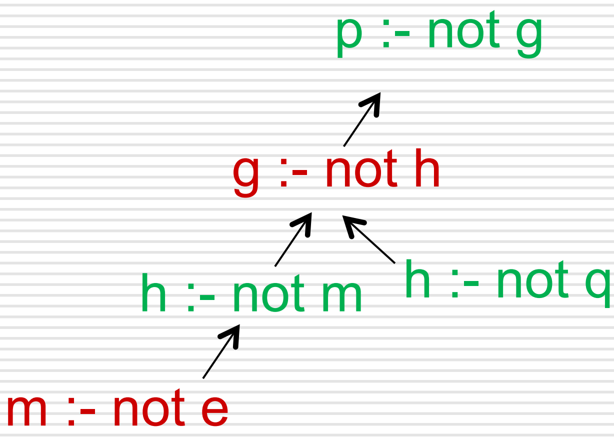
Dialectical Feedback

- Evaluation of arguments in AF instantiated by knowledge in commitment store can provide dialectical feedback to participating agents

  - who is currently winning
  - you should move X
  - the relevant moves to reply to in order to win the dialogue

Currently Ag1 is winning

Does it make sense for Ag2 to move an alternative reply to h :- not m ?



Other types of dialogue

- So far I have described persuasion dialogues in which one agent attempts to persuade another agent of the truth of a claim
- There are other types of argumentation based dialogue, e.g.

Deliberation dialogues in which arguments are exchanged for alternative courses of action (distributed decision making) in which evaluation of arguments implicitly constructed, determines which action choice is warranted by the justified argument

Negotiation dialogues in which one can argue over offers unlike hand-shaking protocols. e.g., instead of offer(Renault) – reject(Renault) – offer(bmw) – reject(bmw) ...

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– argue(Renault safe since EU report)

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Illustrates **nested** (persuasion) dialogue

More on dialogues

- I have only scratched the surface of dialogues
  - Other types, e.g., information seeking, enquiry
  - Strategies and dialogue, eg., choosing which locutions to make based on model of opponent's beliefs

- Further reading

- P. McBurney and S.Parsons. Dialogue games for agent argumentation. In : *Argumentation in Artificial Intelligence* (eds. I.Rahwan and G.Simari) 261-280, Springer,2009

- H. Prakken, Coherence and flexibility in dialogue games for argumentation. *Journal of Logic and Computation* 15 (2005): 1009-1040

-I. Rahwan, S. D. Ramchurn, N. R. Jennings, P. McBurney, S. Parsons and L. Sonenberg (2003). Argumentation-Based Negotiation. *The Knowledge Engineering Review*, Volume 18, No. 4, pages 343-375

-P. McBurney, D. Hitchcock and S. Parsons [2007]: The eightfold way of deliberation dialogue. *International Journal of Intelligent Systems*, 22 (1): 95—132.

-C. Hadjinikolis, Y. Siantos, S. Modgil, E. Black, P. McBurney. *Opponent Modelling in Persuasion Dialogues*. In: Proc. of the 23rd International Joint Conference on Artificial Intelligence (IJCAI 2013).

Multi-agent (automated and human) applications

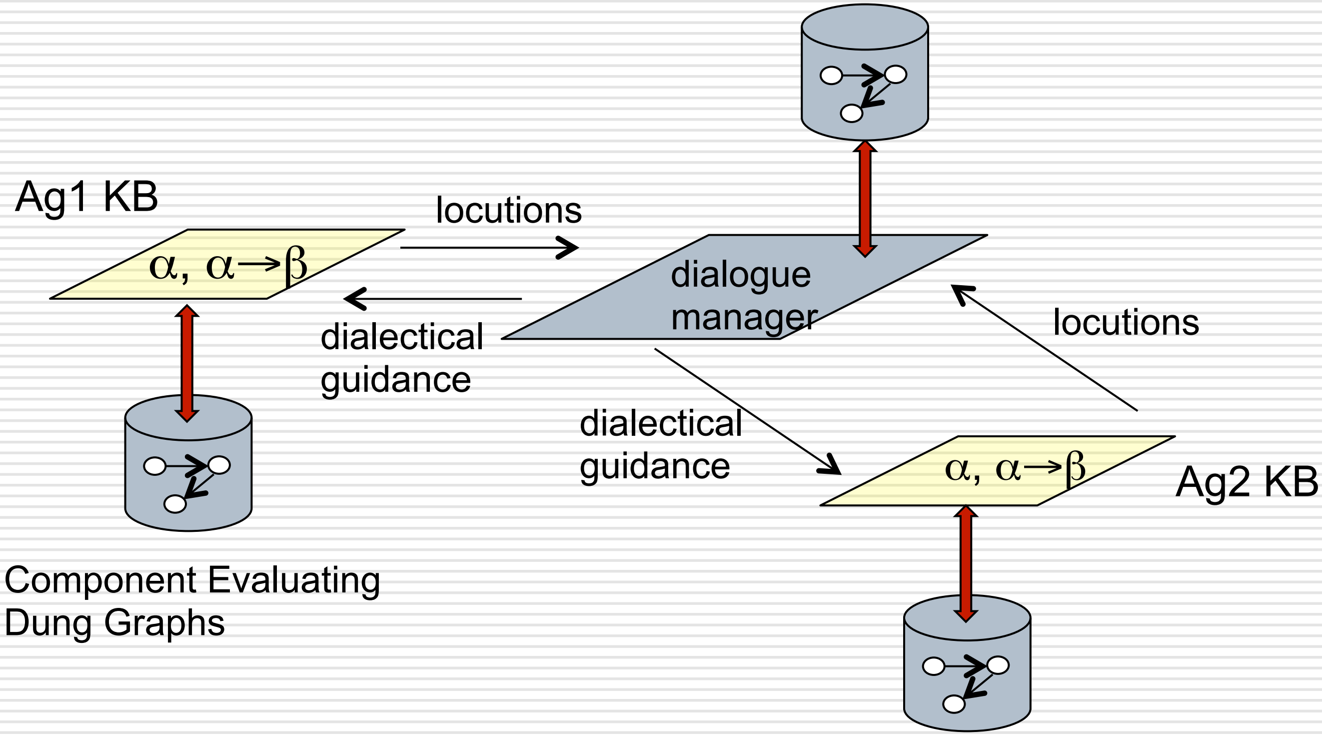
Putting it all together

- So far I have described how
  - argumentation can be deployed by an individual agent making inferences, and in decision making
- - argumentation underpins dialogical interactions in which agents persuade (distributed inference) and deliberate (distributed decision making)

- Previous European projects * have therefore envisaged the following MAS architecture in which agents can reason and communicate

  * **ASPIC** : http://www.cossac.org/projects/aspic and
  ArguGRID : F. Toni, et.al *The ArguGRID Platform: An Overview* ,
  Proc. Grid Economics and Business Models, 5th International Workshop, GECON 2008.

Argumentation Enabled Agent Architectures



Dialogue manager implements protocol specification

Example : CARREL

- CARREL * was a MAS system developed by the ASPIC project
- Defined infrastructure for geographically distributed automated and human agents to exchange and evaluate arguments for transplant organ assignments
- Problem that many organs get discarded even though some specialists may argue that a given organ is suitable for a given recipient
- CARREL deployed a dialogue manager and linked Dung evaluation engine to mediate exchange and evaluate arguments
- Key challenge was how to integrate human agents in these argumentative deliberations

* P Tolchinsky, S Modgil, K Atkinson, P McBurney, U Cortés: Deliberation dialogues for reasoning about safety critical actions. *Journal of Autonomous Agents and Multi-Agent Systems 25*(2): 209-259 (2012)

P Tolchinsky, U Cortes, S Modgil, F Caballero, A Lopez-Navidad: Increasing Human-Organ Transplant Availability: Argumentation-Based Agent Deliberation*. IEEE Intelligent Systems 21*(6): 30-37 (2006)

The Added Value (2)

- Reinstatement principle intuitive and familiar to human modes of reasoning and debate
- Argumentation based characterisations of computational reasoning understandable and accessible to human reasoning [1]
- Abstractions that accommodate computational and human reasoning can provide bridging role so that [2]:

  - Computational reasoning augments human reasoning

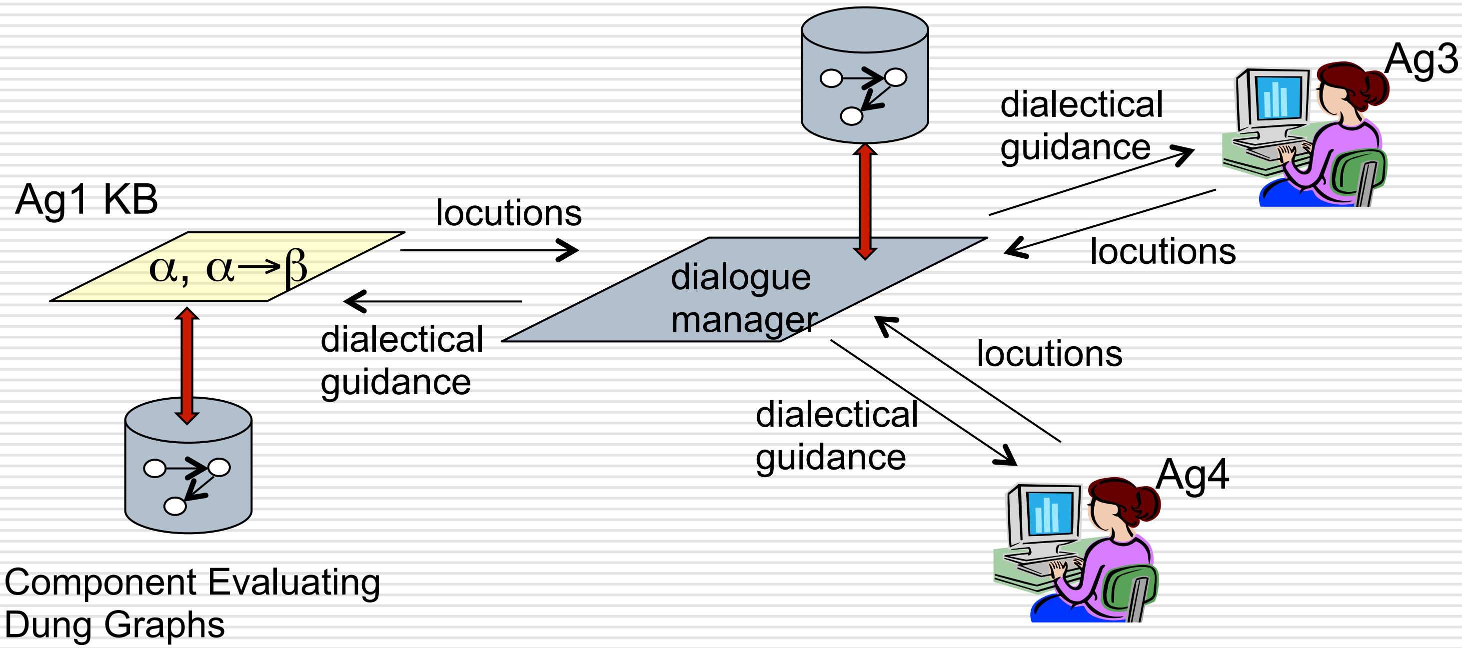
  - Human reasoning augments computational reasoning

  - Advancing AI through integrating human and computational reasoning

1. H. Mercier and D. Sperber. Why do humans reason? arguments for an argumentative theory. *Behavioral and Brain Sciences*, 34(2):57–747, 2011.

2. S. Modgil, F. Toni et.al. *The Added Value of Argumentation*. Book chapter in: Agreement Technologies. Springer Verlag, 2013.

Argumentation Enabled Agent Architectures



Humans given dialectical guidance : => the status of the dialogue and suggestions for how to attack and construct arguments and so fulfil their dialectical obligations (crucial in safety critical domains)

Schemes and Critical Questions

- A key enabling methodology for integrating human argumentation and dialogue is the use of schemes and critical questions
- Initially developed by the philosophical community* they have been further developed by informal and formal logic communities working on argumentation
- Schemes are generic templates for arguments (that can be instantiated by natural and logical languages) with associated critical questions identifying presumptions that can potentially be challenged / counter-argued

*D.Walton. *Argumentation Schemes for Presumptive Reasoning* , Mahwah, N.J., Lawrence Erlbaum Associates, 1996

Example Schemes and Critical Questions

- Argumentation Scheme for Action *

  In circumstances R
  Doing action A
  Will result in circumstances S
  Which will achieve goal G
  So promoting value V

- 16 Critical Questions, including :
  CQ1 Is R true ?
  CQ2 Does A result in S ?
  CQ3 Does G promote V ?
  CQ4 Are there alternative ways of promoting V?
  CQ5: Does A have a side effect which demotes V?

* K. Atkinson, What should we do?: Computational representation of persuasive argument in practical reasoning, PhD thesis, Department of Computer Science, University of Liverpool, Liverpool, UK, 2005

Example Schemes and Critical Questions

- Argumentation from Expert Opinion

  E is an expert in domain D
  Proposition P is in domain D
  E asserts that P is true (false)
  P may be plausibly be taken to be true (false)

- Critical Questions
  CQ1 How credible is E as an expert ?
  CQ2 Is E trustworthy (reliable) ?
  CQ3 Is P consistent with what other experts assert
  :
- Other schemes * include **Appeal from Popular Opinion**, **Argument from Analogy**, **Argument from Correlation to Cause ....** (over 40 schemes and growing)

* http://philosophicaldisquisitions.blogspot.co.uk/2010/03/argumentation-schemes-part-1.html

Use of Schemes and Critical Questions in Argumentation

- Critical Question (CQ) can be used in two ways :

  1) As challenges shifting the burden of proof to the argument's proponent, to justify (**with an argument**) the presumption questioned

  2) As pointers to counter-arguments

- Dialogue manager can prompt exploration of dialectical space of reasoning using schemes and CQ, so that challenges and counter-arguments can be incrementally instantiated and organised into an argumentation framework that is then evaluated to determine which arguments are justified

*D.Walton. *Argumentation Schemes for Presumptive Reasoning* , Mahwah, N.J., Lawrence Erlbaum Associates, 1996

Example (CQ as a challenge)

In circumstances 'Asad has chem_weap'
Doing action 'invade Syria'
Will result in circumstances 'removing Asad from power'
Which will achieve goal 'removal of chem_weap'
So promoting value 'world peace'

↑

CQ1 Is Asad has chem_weap true ?

*D.Walton. *Argumentation Schemes for Presumptive Reasoning* , Mahwah, N.J., Lawrence Erlbaum Associates, 1996

Example (responding to a challenge with an argument instantiating a scheme)

In circumstances ‘Asad has chem_weap’
Doing action ‘invade Syria’
Will result in circumstances ‘removing Asad from power’
Which will achieve goal ‘removal of chem_weap’
So promoting value ‘world peace’

↑

CQ1 Is Asad has chem_weap true ?

↑

Blick is an expert in domain chem_weap
Asad has chem_weap is in domain chem_weap
Blick asserts Asad has chem_weap is true
Asad has chem_weap is plausibly true

Example (CQ as a counter-argument)

In circumstances ‘Asad has chem_weap’
Doing action ‘invade Syria’
Will result in circumstances ‘removing Asad from power’
Which will achieve goal ‘removal of chem_weap’
So promoting value ‘world peace’

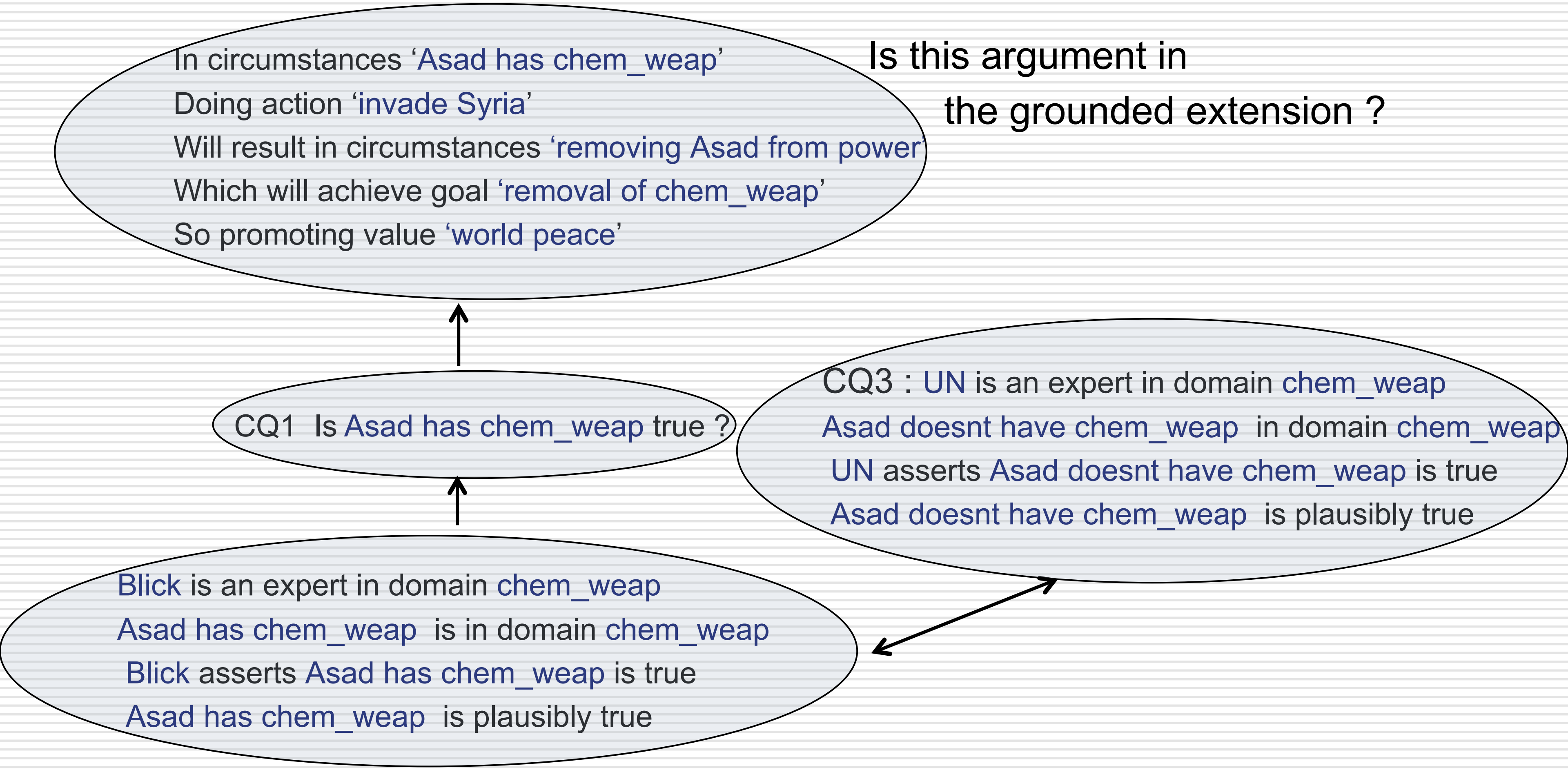
CQ1 Is Asad has chem_weap true ?

CQ3 : UN is an expert in domain chem_weap
Asad doesnt have chem_weap in domain chem_weap
UN asserts Asad doesnt have chem_weap is true
Asad doesnt have chem_weap is plausibly true

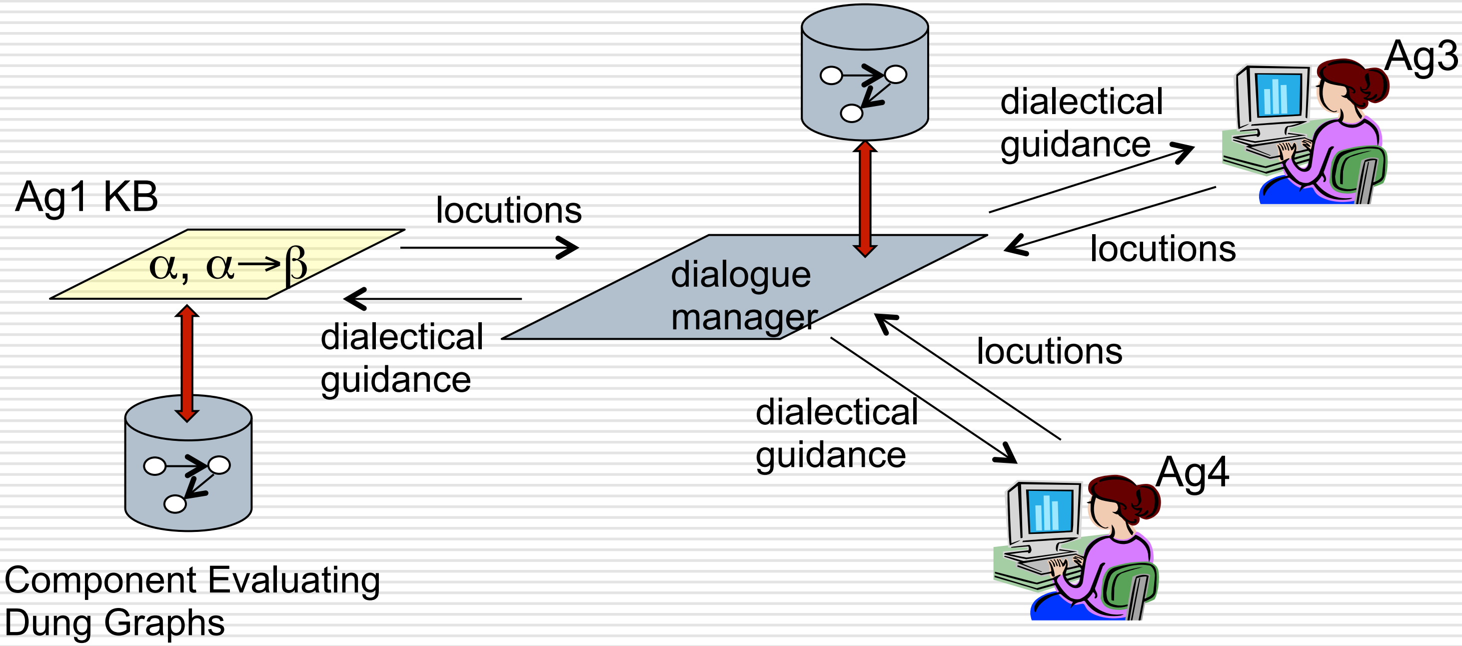
Blick is an expert in domain chem_weap
Asad has chem_weap is in domain chem_weap
Blick asserts Asad has chem_weap is true
Asad has chem_weap is plausibly true

Example (CQ as a counter-argument)

Is this argument in
the grounded extension ?



Argumentation Enabled Agent Architectures



Dialectical guidance includes provision of schemes and critical questions that agents can use as challenges or as counter-arguments instantiating schemes

Example : CARREL

- CARREL MAS system for geographically distributed automated and human agents to exchange and evaluate arguments for transplant organ assignments
- Key challenge was how to integrate human agents in these argumentative deliberations
- CARREL deployed a dialogue manager and linked Dung evaluation engine. Dialogue manager provided schemes and CQ to prompt submission of arguments, challenges and counter-arguments
- However schemes too generic. Therefore domain specific schemes and CQ elicited from domain experts

* P. Tolchinsky, S. Modgil, U. Cortés: Argument Schemes and Critical Questions for Heterogeneous Agents to Argue over the Viability of a Human Organ for Transplantation.
AAAI Spring Symposium: Argumentation for Consumers of Healthcare 2006:

Example : CARREL

Non-Viability scheme 1:
Donor D of organ O had condition C
And C is a contraindication for donating O
Therefore, organ Ois non-viable.

NVS CQ1: Is it the case that donor D had a history of C ?
NVS CQ2: Is it the case that a history of C is a contraindication for donating O ?

No disease associated with history scheme: (instantiated as a NVA CQ2 counter-arg)
If donor D did not have the disease E that is a manifestation of C
Then it is not the case that: if Donor D of organ O had a history of C then C is a contraindication for donating O

E.g., C = *smoking history* and E = *chronic obstructive pulmonary disease*

Finally – From networks of locutions to computational knowledge *

- Idea is that generalisations of Dung graphs to include support relations, multiple attacks …. should be understood as relating natural language locutions where the abstract relations represent assumed shared knowledge

- Goal is to provide dialectical guidance so as to reveal assumed shared knowledge

- This goal serves overall purpose of reifying from the abstract to the concrete so that one can instantiate AF and compute justified arguments

- S. Modgil. Revisiting Abstract Argumentation. In : *Theory and Applications of Formal Argumentation (co-located with IJCAI 2013).*

Example

X = Blair is no longer a public figure and the information is private : therefore we should not publish

Y = But Blair is middle east envoy

"But" indicates that Y attacks X, but Y is an enthymeme – an incomplete argument – since "Blair is middle east envoy" neither logically negates

"Blair is no longer a public figure" or "the information is private"

Dialectical guidance should reveal which reification of the abstract attack relation is assumed : m_e_a => pub_fig or m_e_a => ¬ info_priv

Only then can one instantiate the implicitly defined arguments and evaluate in an AF

- S. Modgil. Revisiting Abstract Argumentation. In : *Theory and Applications of Formal Argumentation (co-located with IJCAI 2013).*

Conclusions

- Logic-based argumentation – a dialectical paradigm for reasoning in the presence of uncertainty and conflict that is familiar in human reasoning and debate and can be naturally generalised to distributed reasoning and dialogue integrating human and automated agents.

Key research challenges

- rationality postulates (not fully solved)
- dialogues underpinned by extended argumentation frameworks
- implementations
- integrating other modes of human argumentation
- natural language processing

:

Questions and Discussion

- What are your research challenges ?
- Is anyone working on MAS in which agents reason in a distributed way ?
- Can we think about how argumentation might be used ?