Lecture 6

Argumentation:
# An Overview

INST0074

Lecture Outline

- Main Concepts
  - Argumentation, Argument, Argumentation theory
- Informal approaches
- Formal approaches
  - Argumentation-based inference
  - Argumentation-based dialogues

What is argumentation

- An everyday human activity

- Exchange of arguments on a topic

- Resolving conflicts of opinion

- Influencing the thoughts or views of others
  - "*the ability to consider, for a given question, the elements that are useful to persuade someone*" (Aristotle)

- A way of thinking

- A cognitive process

- Drawing conclusions based on evidence, which may be incomplete or contradictory

A formal definition

- *"a verbal, social, and rational activity aimed at convincing a reasonable critic of the acceptability of a standpoint by putting forward a constellation of propositions justifying or refuting the proposition expressed in the standpoint."*
    - Eemeren, F. H. v., & Grootendorst, R. (2004). A Systematic Theory of Argumentation: The Pragma-dialectical Approach. Cambridge University Press.

- Discursive activity ("social", "aimed at convincing a reasonable critic")

- Cognitive activity ("verbal", "rational")
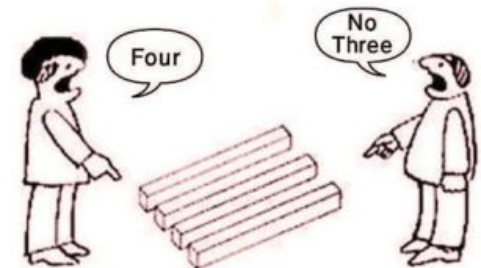
What is argument

- *"any group of propositions of which one is claimed to follow from the others, which are regarded as providing support or grounds for the truth of that one"*
  - Copi, I.M., & Cohen, C. (2002). Introduction to Logic (11th ed.). Upper Saddle River (NJ): Prentice Hall.

- *"the giving of reasons to support or criticize a claim that is questionable, or open to doubt"*
  - D.N. Walton. Fundamentals of Critical Argumentation. Cambridge University Press, Cambridge, 2006.

An online debate in Kialo.com

How does argumentation work?

- Identifying arguments and counter-arguments relevant to an issue
  - *"Animal testing is necessary for medical development"*
  - *"Not all animal testing is done for medical purposes; animals are often tested on by cosmetic companies"*
- Weighing, comparing or evaluating arguments
  - Is the argument valid?
  - Is the supporting evidence valid and strong?
  - How do the different argument appeal to us?
  - What do we value most?
- Drawing a conclusion
  - Decide whether to agree/disagree with banning animal testing

What types of information does it involve?

- Certain (absolutely correct)
  - Dogs are animals.
  - Animals have been used in medical testing.

- Uncertain
  - Animal testing may be best tool to defeat COVID-19.

- Objective (can be observed, measured or verified)
  - Mice share more than 98% DNA with humans.

- Subjective (based on beliefs or opinions)
  - I believe that testing on animals is unethical.

- Hypothetical
  - Animal testing will be banned within the next decade.

Argumentation theory

- *"The study of argumentation in all its manifestations and varieties, irrespective of the intellectual backgrounds, primary research interests and angles of approach of the theorists"*
  - van Eemeren F.H., Garssen B., Krabbe E.C.W., Snoeck Henkemans A.F., Verheij B., Wagemans J.H.M. (2014) Argumentation Theory. In: Handbook of Argumentation Theory. Springer, Dordrecht.

- Disciplines that study argumentation
  - Philosophy
  - Communication studies
  - Informal Logic
  - Cognitive psychology
  - Linguistics
  - Artificial Intelligence

Argumentation in AI

- Formal models of argumentation

- Computer programs that model or support argumentative tasks
  - Identifying arguments, evaluating arguments, drawing conclusions, etc.

- Systems for argumentation-based inference
  - compute conclusions drawn from a given body of possibly incomplete, inconsistent or uncertain information

- Systems for argumentation-based dialogue
  - model argumentation as verbal interaction aimed at resolving conflicts of opinion
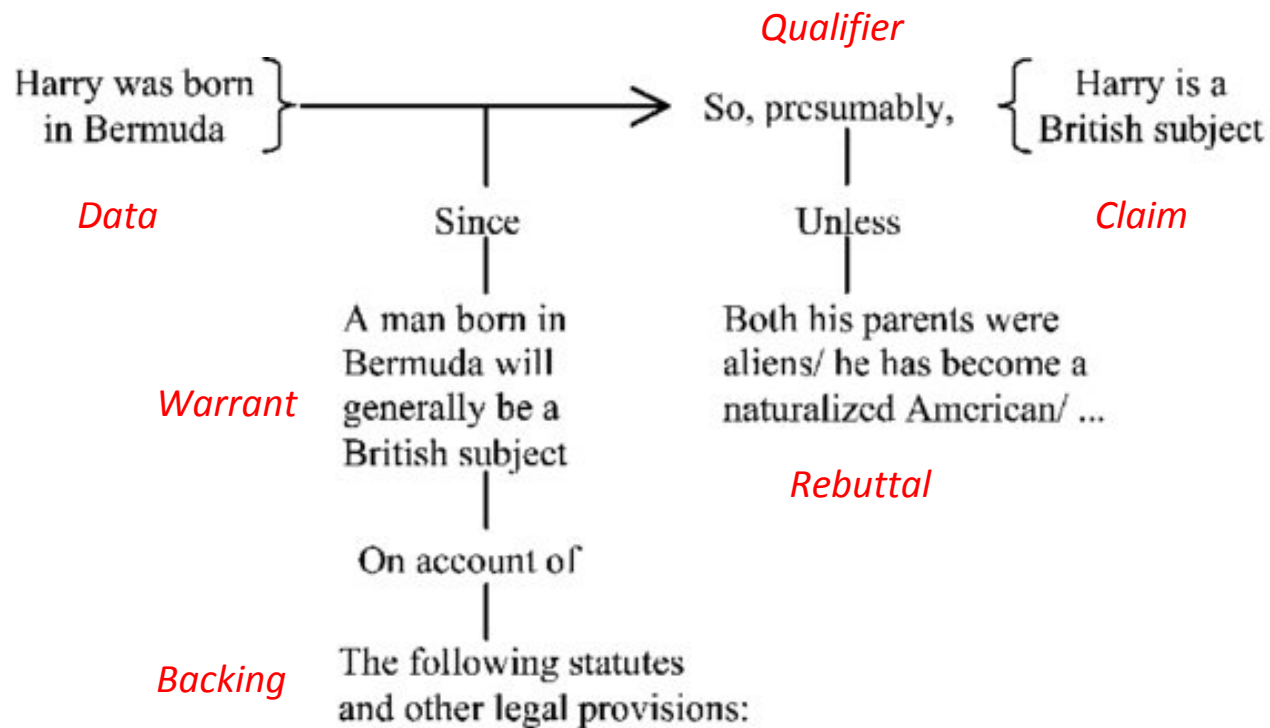 - argumentation protocols, strategies, etc.

Toulmin's model of argumentation

- Toulmin, S. E. (1958). The uses of argument. Cambridge, England: Cambridge University Press. (updated ed. 2003).

- An attempt to describe the elements of argumentation in a non-formal way (informal logic).

- A procedural model of the layout of an argument

- Assessment of arguments depends on the context

- Formal (logic-based) methods are not suitable for evaluating arguments.

Toulmin's model of argumentation

- 1st step: Express a claim that you wish your audience to accept (**claim**)
- 2nd step: Provide the data to support the claim (**data**)
- 3rd step: Provide reasons why the data justify the claim (**warrant**)
- 4th step: Provide evidence to support the warrant (**backing**)
- 5th step: Consider situations that the claim might not be true (**rebuttal**)
- 6th step: Decide the degree to which the claim holds (**qualifier**)

An example (Toulmin, 1958)

Qualifier

Harry was born in Bermuda → So, presumably, Harry is a British subject

Data

Claim

Since

Unless

A man born in Bermuda will generally be a British subject

Both his parents were aliens/ he has become a naturalized American/ ...

Warrant

Rebuttal

On account of

The following statutes and other legal provisions:

Backing

Walton's argumentation schemes

- Walton, D. N. (1996). Argumentation schemes for presumptive reasoning. Mahwah, NJ: Lawrence Erlbaum.

- A form of argumentation that has to do with practical decisions in situations where exact knowledge is insufficient to yield a decisive solution to the problem.

- A defeasible kind of reasoning: Once new evidence or facts appear, initial conclusions may be invalidated.

- Arguments may be challenged by critical questions.

- Argumentation scheme: a template that represents a common type of argument used in everyday dialogues

Argument from Position to know

- **Major Premise**: Source a is in position to know about things in a certain subject domain S containing proposition p.

- **Minor Premise**: a asserts that p *is true* (*false*)

- **Conclusion**: p *is true* (*false*)

- **Critical Questions**:
  - CQ1: Is a in position to know whether p *is true* (*false*)?
  - CQ2: Is a honest (trustworthy, reliable) source?
  - CQ3: Did a assert that p *is true* (*false*)?

- Example: A passer-by who looks familiar with the city said that the main train station is two blocks away. So, it should be two blocks away.

Walton's argumentation schemes

- Argument from witness testimony
- Argument from popular opinion
- Argument from popular practice
- Argument from example
- Argument from composition
- Argument from division
- Argument from oppositions
- Argument from alternatives
- Argument from verbal classification
- Argument from definition to verbal classification
- Argument from vagueness of a verbal classification
- Argument from arbitrariness of a verbal classification
- Argument from interaction of act and person

- Argument from values
- Argument from the group and its members
- Practical reasoning argument
- Argument from waste
- Argument from sunk costs
- Argument from correlation to cause
- Argument from sign
- Argument from evidence to a hypothesis
- Argument from consequences
- Argument from threat
- Argument from fear appeal
- Argument from danger appeal
- Argument from need for help

- Argument from distress
- Argument from commitment
- Ethotic argument
- Generic ad hominem argument
- Pragmatic inconsistency argument
- Argument from inconsistent commitment
- Circumstantial ad hominem argument
- Argument from bias
- Bias ad hominem argument
- Argument from gradualism
- Slippery slope argument

Walton, Douglas N.; Reed, Chris; Macagno, Fabrizio (2008). Argumentation schemes. Cambridge; New York: Cambridge University Press.

Formal models for argumentation-based inference

- Commonsense reasoning (including argumentation) often involves incomplete or inconsistent information

- Limitation of deductive reasoning: If information is incomplete, then nothing useful can be deductively derived, while if it is inconsistent, then anything is deductively implied

- Non-monotonic logics allow 'jumping to conclusions' in the absence of information to the contrary.

- Argumentation is a non-monotonic process.

Pollock's model of argument

- Pollock, J.L. (1987). Defeasible reasoning. Cognitive Science, 11:481-518
- Argument is an inference graph in which a final conclusion is inferred from the premises via intermediate conclusions
- Inference rules (*reasons*) are of two kinds:
  - Deductive (*conclusive*)
  - Defeasible (*prima facie*)
- Arguments can be defeated on its defeasible reasons
  - attack the conclusion of a defeasible inference by supporting a conflicting conclusion (*rebutting defeater*)
  - attack the defeasible inference itself without supporting a conflicting conclusion (*undercutting defeater*)

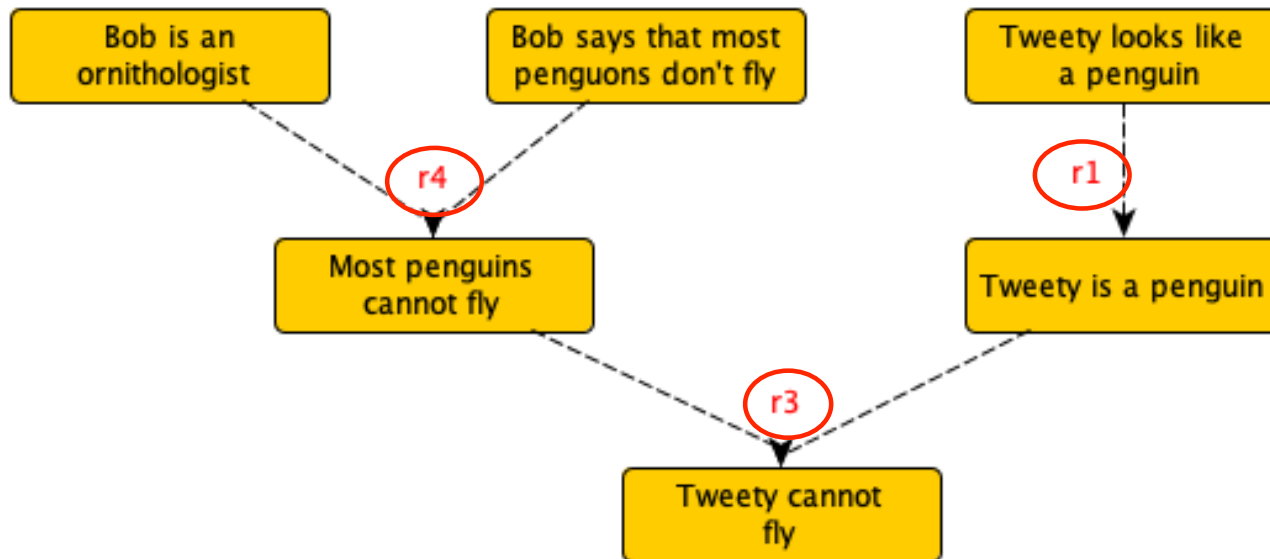# An argument supporting that Tweety can fly
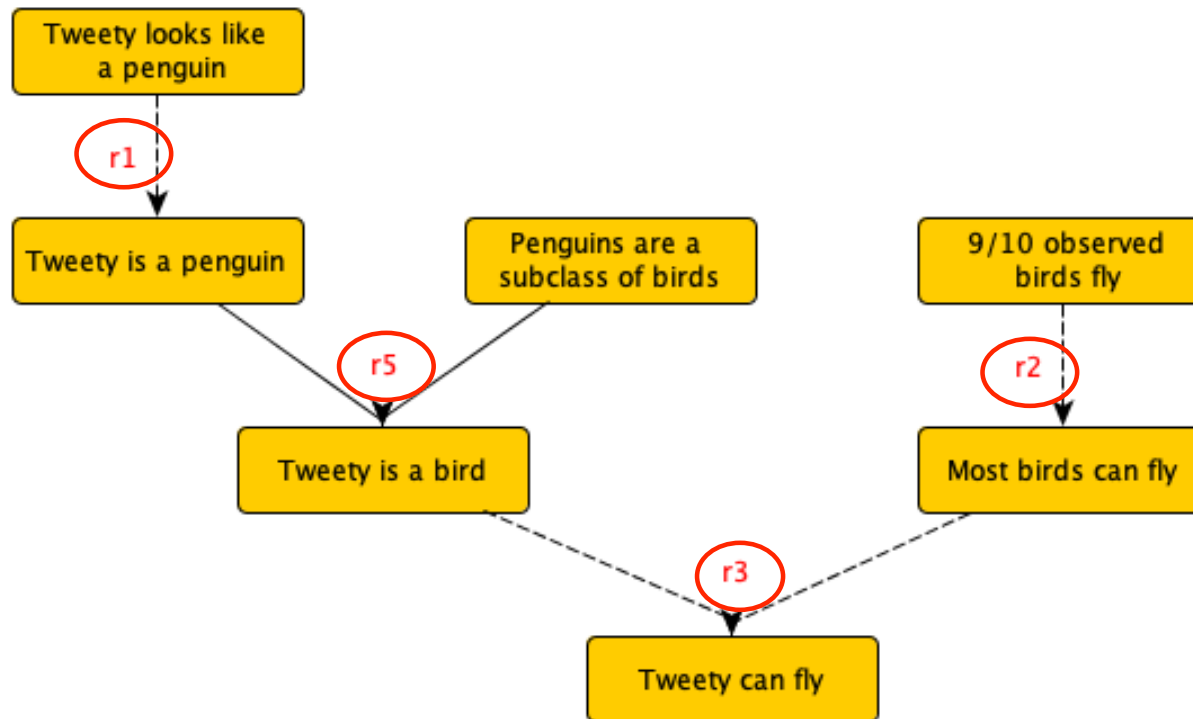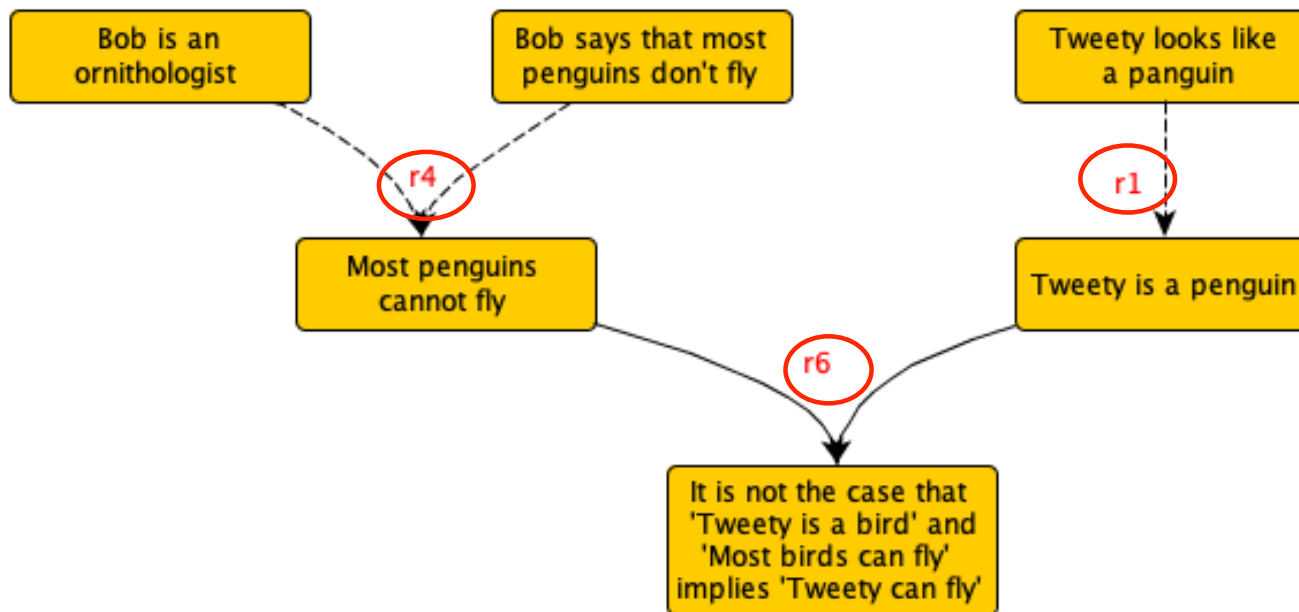

r₁: That an object looks like having property *P* is a defeasible reason for believing that the object has property *P*

r₅: That *P*s are a subclass of *Q*s and *a* is a *P* is a deductive reason for believing that *a* is a *Q*

r₂: That a large percentage of people (more than 50%) observed *P*s are *Q*s is a defeasible reason for believing that most *P*s are *Q*s

r₃: That most *P*s are *Q*s and *x* is a *P* is a defeasible reason for believing that *x* is a *Q*

A rebutting defeater

r₁: That an object looks like having property *P* is a defeasible reason for believing that the object has property *P*

r₄: That an ornithologist says φ about penguins is a defeasible reason for believing φ

r₃: That most *P*s are *Q*s and *x* is a *P* is a defeasible reason for believing that *x* is a *Q*

An undercutting defeater

r_1: That an object looks like having property P is a defeasible reason for believing that the object has property P

r_4: That an ornithologist says φ about penguins is a defeasible reason for believing φ

r_6: That x is an R, most Rs are not Qs and Rs are a subclass of Ps is a deductive reason for believing ¬ r_3
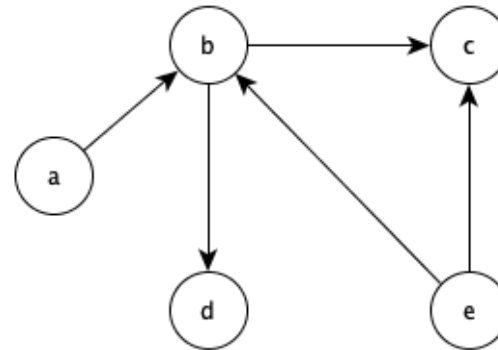
r_3: That most Ps are Qs and x is a P is a defeasible reason for believing that x is a Q

Abstract Argumentation Frameworks

- Dung, P.M. (1995). On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming, and n-person games. Artificial Intelligence, 77:321-357, 1995.

- A simple but elegant model for argument evaluation based on two notions: argument and attack

- The acceptability of an argument depends only on the attacks it receives and not on its internal structure.

- "The one who has the last word loughs"
  - When someone makes a claim and that is the end of the discussion, the claim stands. But when there is an opponent raising a counter-argument to the claim, the claim is no longer accepted.
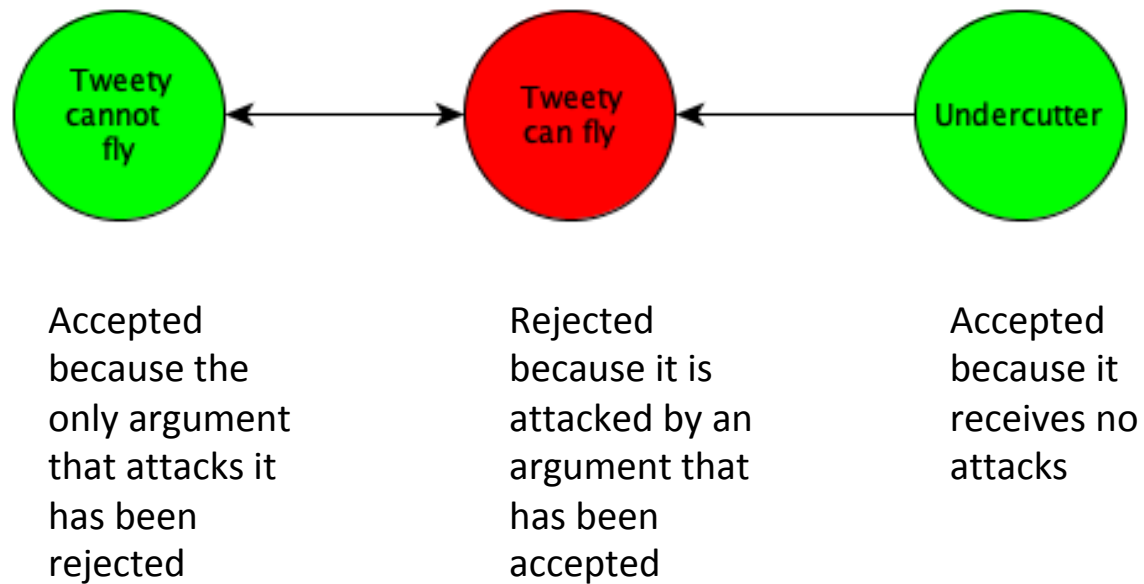
Abstract Argumentation Frameworks

- An argumentation framework is a directed graph, the nodes of which are arguments, whereas the edges represent attacks among the arguments.
- $\mathbf{AF = \{A, R\}, R \subseteq A \times A}$
  - A is a set of arguments
  - R is a binary relation on A

$A = \{a, b, c, d, e\}$
$R = \{(a,b),(b,c),(b,d),(e,b),(e,c)\}$

Can Tweety fly?

Accepted because the only argument that attacks it has been rejected

Rejected because it is attacked by an argument that has been accepted

Accepted because it receives no attacks

Abstract vs. Structured Argumentation

- Abstract Frameworks
  - Each argument is regarded as atomic (no internal structure)
  - Dung's AAF and its extensions
    - Attacks on attacks, joint attacks, support relation, preferences, weights, etc.
  - Other approaches
    - Abstract Dialectical Frameworks

- Structured Frameworks
  - They use a formal language for representing knowledge
  - Arguments can be constructed from the available knowledge
  - The premises and claim of the argument are made explicit
  - Relationship between premises and claim is formally defined
  - ASPIC, ABA, Deductive argumentation, DeLP

Argumentation-based dialogues

- Two or more agents aim to resolve a conflict of opinion by verbal means
- Relevant information
  - Content of the arguments
  - Knowledge, beliefs, preferences, goals of the agents
  - Credibility of the agents
  - Changes in an agent's knowledge and beliefs
  - Context of the dialogue

Classification of dialogues

- Persuasion
  - Aims to change the audience's opinions or beliefs

- Negotiation
  - Aims to resolve a conflict of opinion by reaching a deal

- Information seeking
  - Aims to enrich an agent's knowledge

- Deliberation
  - Aims to reach a decision on a course of action

- Inquiry
  - Aims to prove a disputable or questionable proposition

Walton, D.N. and Krabbe, E.C.W. (1995). Commitment in Dialogue. Basic Concepts of Interpersonal Reasoning. State University of New York Press, Albany, NY.

Formal dialogue systems: Components

- A dialogue goal

- A set of participants (at least two) and a set of roles

- A logic L consisting of a topic language L_t and a set R of inference rules over L_t

- A communication language L_c specifying the types of speech acts the participants can perform during the dialogue

- A context $K \subseteq L_t$ specifying the common prior knowledge of the participants

- A belief base $B_a \subseteq L_t$ for each agent a specifying the agent's knowledge and beliefs

Formal dialogue systems: Components

- A set of commitments $C_a \subseteq L_t$ for each agent a specifying the agent's publicly declared points of view about a proposition

- A set of effect rules C for L_c, specifying the effects of each statement on the commitments of the participants

- A protocol P for L_c, specifying the allowed speech acts at each stage of a dialogue

- A set of outcome rules defining the outcome of a dialogue

A formal model for persuasion dialogues

- Prakken, H. (2006). Formal systems for persuasion dialogue. The Knowledge Engineering Review, 21:163–188.

- Dialogue goal: Resolution of a conflict of opinion about one or more propositions (topics), $T \subseteq L_t$

- Roles: For each topic $t \in T$, there is a set of proponents of t, *prop(t)* $\subseteq A$ (*A is the set of participants*) and a set of opponents of t, *opp(t)* $\subseteq A$

- The outcome rules define for a dialogue d, context K and topic t the winners and losers with respect to t

A formal model for persuasion dialogues

- Communication language

claim φ	The speaker asserts that φ is the case.
why φ	The speaker challenges that φ is the case and asks for reasons why it would be the case.
concede φ	The speaker admits that φ is the case.
retract φ	The speaker declares that she is not committed (any more) to φ.
φ since S	The speaker provides reasons why φ is the case.
question φ	The speaker asks another participant's opinion on whether φ is the case.

A formal model for persuasion dialogues

- Protocol

Speech act	Possible replies
claim φ	*why φ, claim ¬φ, concede φ*
why φ	*φ since S, retract φ*
concede φ	
retract φ	
φ since S	*why ψ (ψ∈S), concede ψ (ψ∈S)*
question φ	*claim φ, claim ¬φ, retract φ*

A formal model for persuasion dialogues

- Effect rules
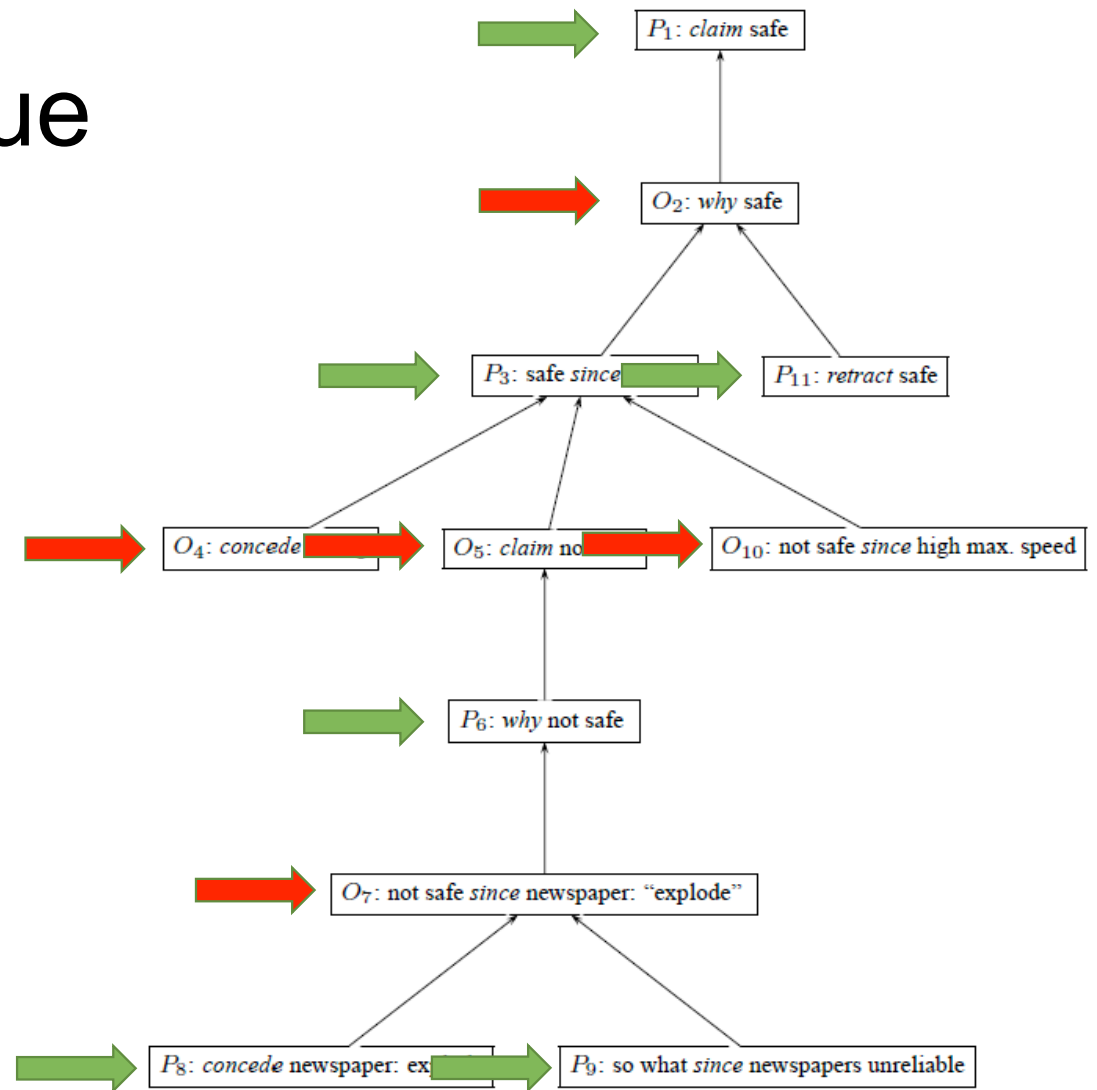 - a denotes a participant, m a dialogue move, d the sequence of previous moves
- If $a(m) = claim\ \varphi$ then $C_a(d,m) = C_a(d) \cup \{\varphi\}$
- If $a(m) = why\ \varphi$ then $C_a(d,m) = C_a(d)$
- If $a(m) = concede\ \varphi$ then $C_a(d,m) = C_a(d) \cup \{\varphi\}$
- If $a(m) = retract\ \varphi$ then $C_a(d,m) = C_a(d) - \{\varphi\}$
- If $a(m) = \varphi\ since\ S$ then $C_a(d,m) = C_a(d) \cup \{\varphi\} \cup S$

An example persuasion dialogue

- Paul: My car is safe.
- Olga: Why is your car safe?
- Paul: Since it has an airbag.
- Olga: That is true but this does not make your car safe.
- Paul: Why does that not make my care safe?
- Olga: Since the newspapers recently reported on airbags expanding without cause.
- Paul: Yes, that is what the newspapers say but that does not prove anything, since newspaper reports are very unreliable sources of technological information.
- Olga: Still your car is still not safe, since its maximum speed is very high
- Paul: OK, I was wrong that my car is safe.

Model of the dialogue

Move	C_P	C_O
P_1	safe	
O_2		
P_3	safe, airbag	
O_4		airbag
O_5		airbag, ¬safe
P_6		
O_7		airbag, ¬safe, newspaper
P_8	safe, airbag, newspaper	
P_9	safe, airbag, newspaper, unreliable	
O_{10}		airbag, ¬safe, newspaper, high-speed
P_{11}	airbag, newspaper, unreliable	

P_1: claim safe

O_2: why safe

P_3: safe since

P_{11}: retract safe

O_4: concede

O_5: claim no

O_{10}: not safe since high max. speed

P_6: why not safe

O_7: not safe since newspaper: "explode"

P_8: concede newspaper: ex

P_9: so what since newspapers unreliable

Research in argumentation-based dialogue

- Less advanced than argumentation-based inference
- Research in formal models of dialogue
  - Focused mostly on communication languages and protocols
- Research in agent behaviour
  - Focused on strategies, tactics, heuristics
  - Influenced by game theory