Argumentation in Artificial Intelligence, With Applications in the Law

Course at the Institute of Logic and Cognition, Sun Yat-Sen University

Ia Introduction

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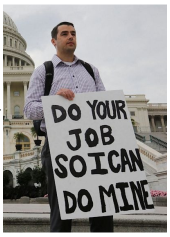
← An argumentative situation

← An argumentative situation

Consequences →



← An argumentative situation

Consequences →

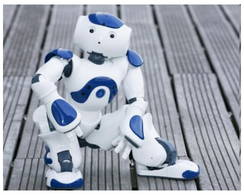
↑ A normative situation

Legal argument: setting

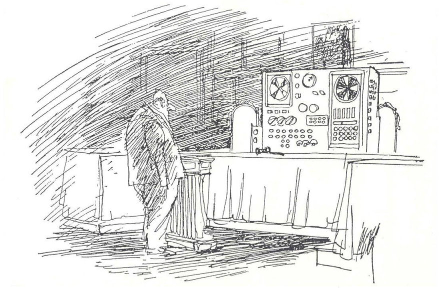
- There is a **conflict** between parties
- **Argumentation** is a **tool** to find a reasonable, practical, acceptable **solution**
- Parties are **normatively bound**

The law

Artificial Intelligence

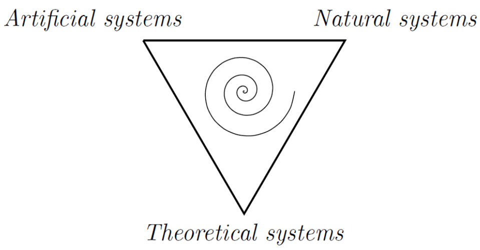


Artificial Intelligence and Law



Maar edelachtbare, u drinkt toch ook wel eens een glaasje?

But, Your Honour, you sometimes have a drink too, don't you?



Theoretical arguments

$p \rightarrow q$	If p, then q
$\neg q$	Not q
$\neg p$	Therefore: Not p

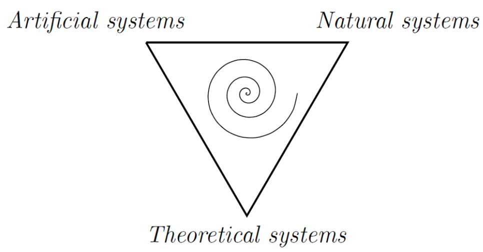
p	q	$p \rightarrow q$	$q \rightarrow (p \rightarrow q)$
t	t	t	t
t	f	f	t
f	t	t	t
f	t	t	t

Natural arguments

Artificial arguments

```
theorem
  not ex n st for m holds n >= m
proof

  assume not thesis;
  then consider n such that
A1: for m holds n >= m;

  set n' = n + 2;

  n' > n by XREAL_1:31;

  then not for m holds n >= m;

  hence contradiction by A1;

end;
```

Computer understandable proof taken from a slide by Freek Wiedijk "Formal proof with the computer", Johann Bernoulli Colloquium, University of Groningen, 2010-03-17, 16:15



Real humans, 2012

This course

The course aims to provide an overview of argumentation as it is studied in Artificial Intelligence, led by applications in the field of law.

Goals:

- Acquire knowledge of the study of argumentation in Artificial Intelligence
- Acquire knowledge of the applications in the field of law
- Develop critical reflection about the subject matter and the state-of-the-art in the field

Lecture Ia: Introduction
Lecture Ib: Abstract Argumentation and Argument Structure

Lecture IIa: Argument Schemes and Argumentation Dialogues
Lecture IIb: Argumentation with Rules and with Cases

Lecture IIIa: Reasoning with Evidence
Lecture IIIb: Argument Strength and Probabilities

Literature

Chapter 11 (draft) of

Handbook of Argumentation Theory
A Comprehensive Overview of the State of the Art

Frans H. van Eemeren, University of Amsterdam
Bart Garssen, University of Amsterdam
Erik C. W. Krabbe, University of Groningen
A. Francisca Snoeck Henkemans, University of Amsterdam
Bart Verheij, University of Groningen
Jean H. M. Wagemans, University of Amsterdam

To appear 2014

Warning

This course
is about
research

Loose ends
Confusing, differing terminology

~~Warning~~ Don't worry

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is about
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Loose ends
Confusing, differing terminology

IA Introduction

Topics:
- Argumentation in Artificial Intelligence
- Historical Background

Goals:
- Get an overview of the course and its subject matter
- Acquire insight about the historical background

Literature:
- Van Eemeren et al. (in preparation). Sections 11.1-11-3.

Historical background

Where did research on argumentation in Artificial Intelligence come from?

1. Nonmonotonic logic

2. Defeasible reasoning

Nonmonotonic logic

A logic is **non-monotonic** when a conclusion that, according to the logic, follows from certain premises need not always follow when premises are added.

In contrast, classical logic is monotonic:

IF
  P implies Q
THEN
  P, P' implies Q

Reiter's logic for default reasoning

Birds fly
  BIRD(x) : M FLY(x) / FLY(x)

A penguin does not fly
  PENGUIN(x) → ¬FLY(x)

FLY(t) follows from BIRD(t)

FLY(t) does not follow from BIRD(t), PENGUIN(t)

Reiter's logic for default reasoning

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Logic programming

parent(pam, bob)
parent(tom, bob)

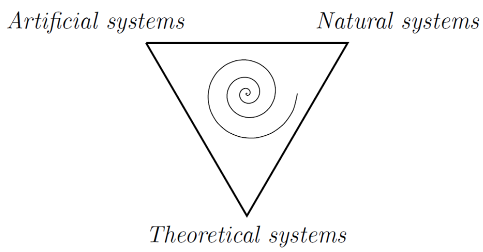
?- parent(pam, bob).
YES
?- parent(may, bob)
NO

Closed world assumption
Negation as failure

Impact of the study of non-monotonic logic

- Very successful as a research enterprise
- Innovations in computer programming
- Not all expectations fulfilled

Ginsberg 1994:
The field put itself "in a position where it is almost impossible for our work to be validated by anyone other than a member of our **small subcommunity** of Artificial Intelligence as a whole"

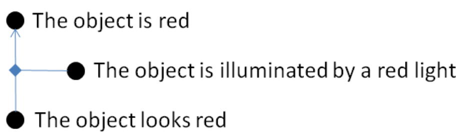


Defeasible reasoning

In 1987, John Pollock published the paper 'Defeasible reasoning' in the *Cognitive Science* journal.

What in AI is called "non-monotonic reasoning" coincides with the philosophical notion of "defeasible reasoning".

Pollock's red light example



Undercutting defeat

Theory of warrant

A proposition is *warranted* in an epistemic situation if and only if an ideal reasoner starting in that situation would be justified in believing the proposition.

Here justification is based on the **existence of an undefeated argument** with the proposition as conclusion.

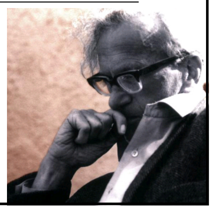
Classes of specific reasons

(1) Deductive reasons
(2) Perception
(3) Memory
(4) Statistical syllogism
(5) Induction

Pollock 1995, *Cognitive Carpentry*

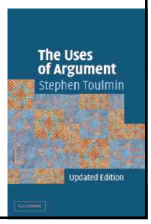
H. L. A. Hart 1948

[...] the accusations and claims upon which law courts adjudicate can usually be challenged or opposed in two ways. **First**, by a denial of the facts upon which they are based [...] and **secondly** by something quite different, namely a plea that although all the circumstances on which a claim could succeed are present, yet in the particular case, the claim or accusation should not succeed because other circumstances are present which brings the case under some recognized head of exception, the effect of which is either to **defeat** the claim or accusation altogether, or to "reduce" it so that only a weaker claim can be sustained (Hart, 1951, pp. 147-148; also quoted by Loui, 1995. p. 22).

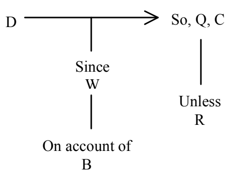


Main themes of Toulmin (1958)

1. Argument analysis involves half a dozen distinct elements, not just two.
2. Many, if not most, arguments are substantial, hence defeasible.
3. Standards of good reasoning and argument assessment are non-universal.
4. Logic is to be regarded as generalised jurisprudence.

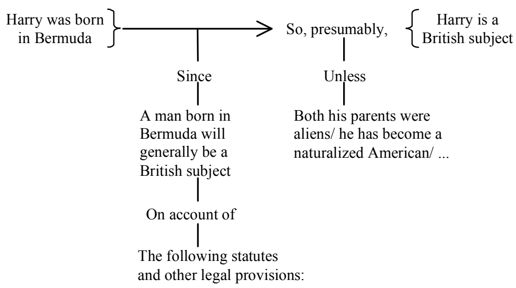


Toulmin's model



Hitchcock, D., & B. Verheij (eds.) (2006). *Arguing on the Toulmin Model. New Essays in Argument Analysis and Evaluation.* Argumentation Library, Vol. 10. Springer, Dordrecht.
Hitchcock, D. & B. Verheij (2005). The Toulmin model today: Introduction to special issue of Argumentation on contemporary work using Stephen Edelston Toulmin's layout of arguments. *Argumentation*, Vol. 19, No. 3, pp. 255-258.

Toulmin's model



Datum and claim

Harry was born in Bermuda → **Harry is a British subject**

Datum and claim

$$\frac{D \qquad D \sim> C}{C}$$

Modus ponens

D: Harry was born in Bermuda.
C: Harry is a British subject.
D ~> C: If Harry was born in Bermuda, he is a British subject.

Datum and claim

Harry was born in Bermuda → Harry is a British subject

~~D~~ ~~C~~ D ~> C

Datum and claim

Harry was born in Bermuda → Harry is a British subject

D ~~C~~ ~~D ~> C~~

On arguments and Modus ponens

1. Harry was born in Bermuda. Therefore, he is a British subject.
2. ~~Harry was born in Bermuda. If Harry was born in Bermuda, he is a British subject. Therefore, he is a British subject.~~

In the present setting, Modus ponens is *not* a representation of an argument, but specifies how evaluation values are transferred.

Attack I (no warrants)

Harry was born in Bermuda → **Harry is a British subject**

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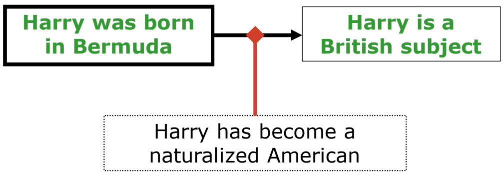

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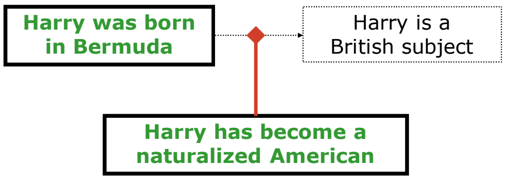

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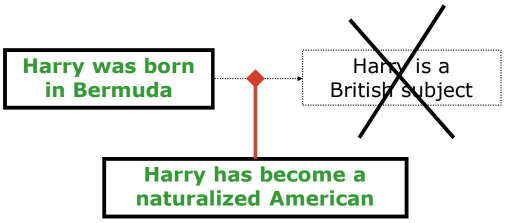
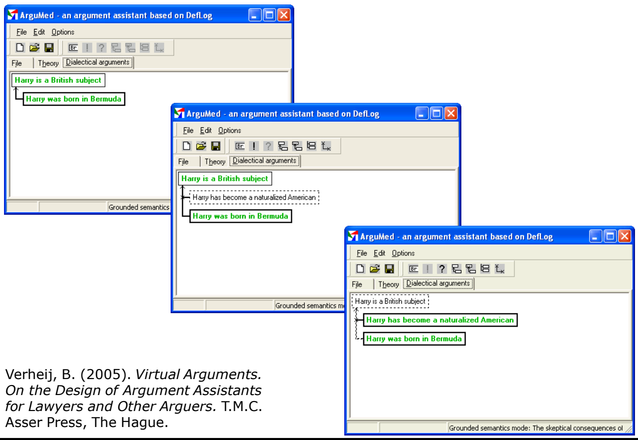
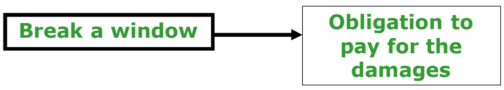




Verheij, B. (2005). *Virtual Arguments. On the Design of Argument Assistants for Lawyers and Other Arguers.* T.M.C. Asser Press, The Hague.

Reinstatement



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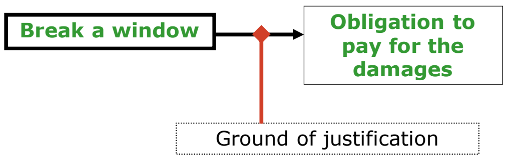

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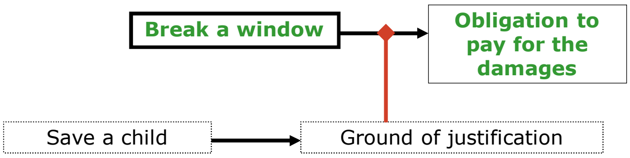

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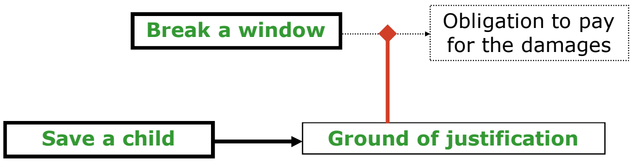

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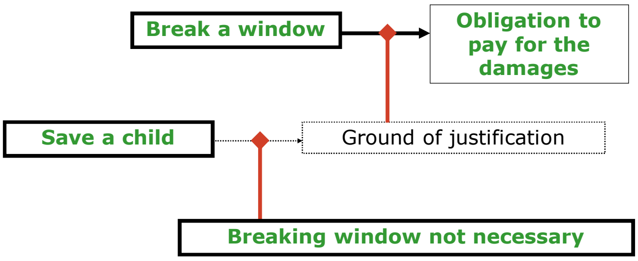

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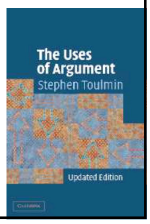

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Stanford CODEX university of groningen

For more information on Toulmin & argumentation in Artificial Intelligence, see:

Verheij, B. (2009). The Toulmin Argument Model in Artificial Intelligence. Or: How Semi-Formal, Defeasible Argumentation Schemes Creep into Logic. *Argumentation in Artificial Intelligence* (eds. Rahwan, I., & Simari, G.), 219-238. Dordrecht: Springer.

Verheij, B. (2005). Evaluating Arguments Based on Toulmin's Scheme. *Argumentation* 19 (3), 347-371.