

## Argumentation in Artificial Intelligence, With Applications in the Law

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

### I Ib Argumentation with Rules and with Cases

Bart Verheij  
CodeX, Stanford University  
Artificial Intelligence, University of Groningen  
[www.stanford.edu/~bartv](http://www.stanford.edu/~bartv), [www.ai.rug.nl/~verheij](http://www.ai.rug.nl/~verheij)



Stanford



CODEX  
The Stanford Center for Legal Informatics



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## Ia Introduction Ib Abstract Argumentation, Argument Structure IIa Argument Schemes and Argumentation Dialogues

### I Ib Argumentation with Rules and with Cases

#### Topics:

Reasoning with Rules  
Case-based Reasoning

#### Goals:

Acquire knowledge about reasoning with rules  
Acquire knowledge about case-based reasoning  
Acquire insight into the relations between reasoning with  
rules and case-based reasoning

#### Literature:

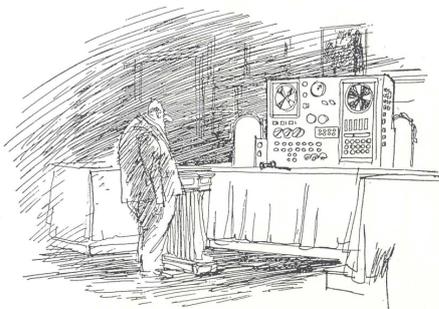
Van Eemeren et al. (in preparation). Sections 11.8, 11.9

## Machines can decide legal cases (?)

Deciding legal cases consists of applying the law.  
The law consists of rules.  
Machines can apply rules.

THEREFORE:

Machines can decide legal cases.



*Maar edelachtbare, u drinkt toch ook wel eens een glaasje?*  
But, Your Honour, you sometimes have a drink too, don't you?

## Some hard questions

Deciding legal cases consists of applying the law.  
-> Is applying the law sufficient for deciding cases?  
-> How does one apply the law?

The law consists of rules.

-> Does it?  
-> Where are they?

Machines can apply rules.

-> Can they?

THEREFORE:

Machines can decide legal cases.

-> Well, I don't know!

Working hypothesis:

*Deciding legal cases can be automated.*

Research agenda:

*Find out how!*

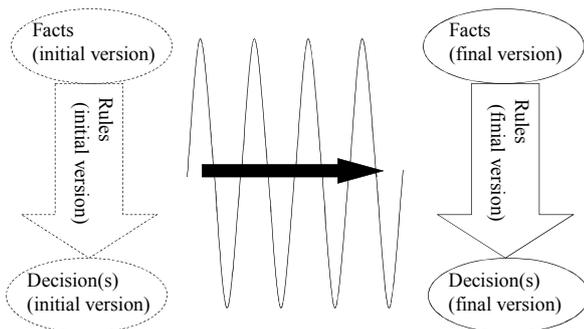
## Law and artificial intelligence

The tension in the law between *legal security* on the one hand and *justice* on the other is related to the *gof-ai* vs. *new-ai* dichotomy.

The former are *top-down* and focus on *explicit knowledge* (rules, logic), the latter are *bottom-up* and use *implicit knowledge* (discretion, case analogy, learning, self-organisation).

The law has a long history of struggling with this tension and developed pragmatic approaches.

## Theory construction



## Legal codes

Example:

Art. 300 of the Dutch Criminal Code

1. Inflicting bodily harm is punishable with up to two years of imprisonment or a fine of the fourth category.
2. When the fact causes grievous bodily harm, the accused is punished with up to four years of imprisonment or a fine of the fourth category.
3. []

## Precedents

Example:

Supreme Court July 9, 2002, NJ 2002, 499

Theft requires the taking away of a good. Can one steal an already stolen car? The Supreme Court's answer is: yes.

## Reasoning with rules and with cases

Rule-based reasoning:

Apply general rules

Example:

John is a thief. (There is a rule that) Thieves are punishable.  
THEREFORE: John is punishable.

Case-based reasoning:

Follow analogous cases

Example:

John is a thief. (There is a precedent in which) Peter was punishable as a thief.  
THEREFORE: John is punishable.

## Reasoning with rules

$d_1$ :  $x$  is a contract  $\Rightarrow x$  only binds its parties  
 $d_2$ :  $x$  is a lease of house  $y \Rightarrow x$  binds all owners of  $y$   
 $d_3$ :  $x$  is a lease of house  $y \wedge$  tenant has agreed in  $x$  that  $x$  only binds its parties  $\Rightarrow x$  only binds its parties

contract lease of a house:

both  $d_1$  and  $d_2$  seem to apply; application of  $d_2$  blocks  $d_1$  (by a form of specificity defeat)

also tenant has agreed that only parties are bound:

application of rule  $d_3$  blocks the application of rule  $d_2$ , hence the application of  $d_1$  is no longer blocked

Prakken 1997

## Reason-Based Logic

punishable: thief( $x$ )  $\Rightarrow$  punishable( $x$ )  
Thief(john)  
THEREFORE  
Applicable(thief(john)  $\Rightarrow$  punishable(john))

This gives a reason that the rule ought to be applied.

If there are no reasons against the rule's application, this leads to the obligation to apply the rule.

Reasons are weighed, but not numerically.

Hage 1997

## Dworkin (1978): rules versus principles

Legal *rules* seem to lead directly to their conclusion when they are applied.

Legal *principles* are not as direct, and merely give rise to a reason for their conclusion.

## Dworkin (1978): rules versus principles

	Rule	Principle
Application	Conclusion	Reason
Conflict	Contradiction	Weighing
Other rules and principles	Independent	Dependent

## Example

Mary's bike is stolen.  
John buys the bike from the thief.  
*Who owns the bike?*

Both Mary and John have a reasonable claim to the bike:

Ownership is not broken by theft.  
Buying gives ownership.

The law provides rules to resolve conflicting principles *in a generic way instead of case by case.*

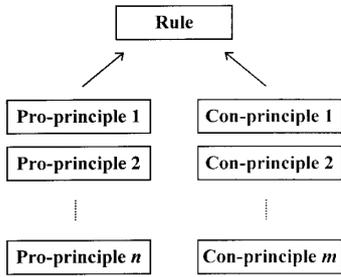
## An integrated model of rules and principles

The differences between rules and principles are merely a matter of degree.

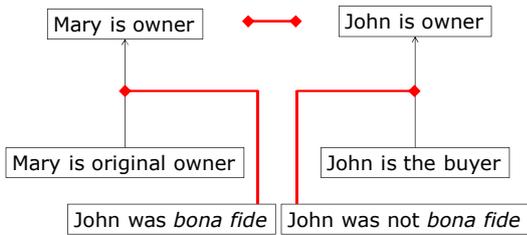
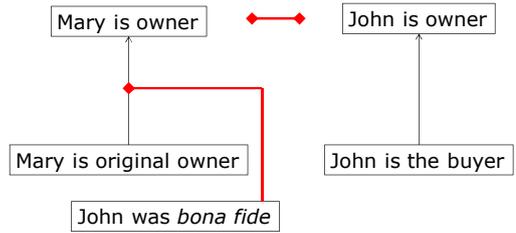
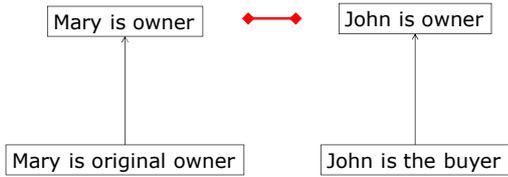
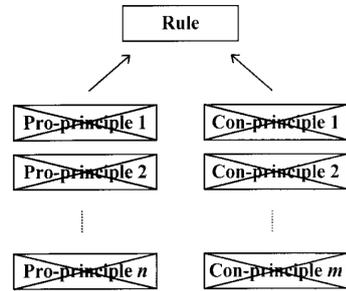
Rules and principles have the same logical structure, but have different behavior in actual reasoning.

Verheij, Hage & Van den Herik 1998

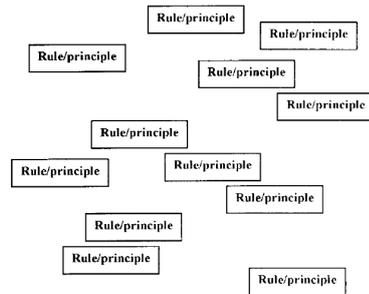
### A rule and its underlying principles



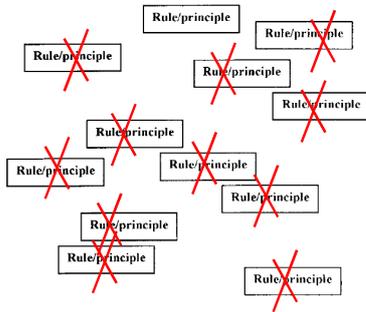
### A rule replaces its underlying principles when it applies



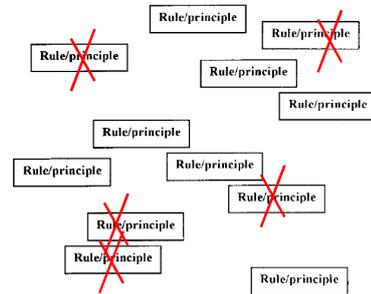
### Interfering rules and principles



## A typical rule applies



## A typical principle applies



## Case-based reasoning

Case-based reasoning is a common type of argumentation in the law, in which legal conclusions are drawn on the basis of previously decided cases.

If some decided case is sufficiently similar to the case at hand, then under the doctrine of *stare decisis* one should not depart from that decision, and the same conclusion should hold.

## Case-based reasoning

Issue:

Can a dismissal be voided?

Precedent case:

- + The employee's behavior was always good
- There was a serious act of violence
- Outcome: + (voided)

Current case:

- + The employee's behavior was always good
- There was a serious act of violence
- + The working atmosphere was not affected
- Outcome: ?

## Case-based reasoning

Issue:

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- Outcome: + (voided)



## Ashley's HYPO (1990)

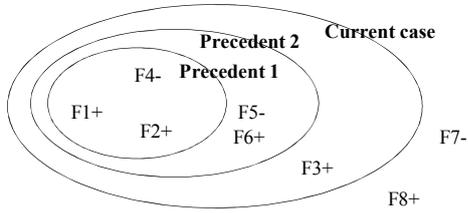
Factors are generalised facts pleading for or against an issue.

Cases are treated as sets of factors.

For precedent cases, the outcome is known.

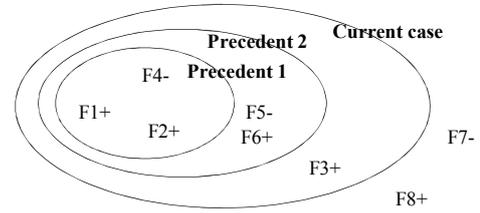


## HYPO



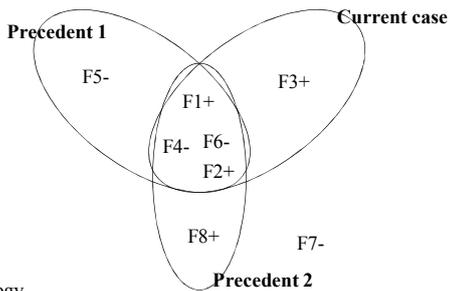
Precedent 1: -  
 Precedent 2: +  
 Current case? By analogy with precedent 2: +

## HYPO



Precedent 1: -  
 Precedent 2: -  
 Current case? Undetermined on the basis of the precedents

## HYPO



Precedent 1: +  
 Precedent 2: +  
 Current case?  
 + by analogy with Precedent 1

## Overview

Legal decision making  
 Case-based reasoning: Hypo  
**Case-based reasoning: entangled dialectical arguments**  
 Are case-based and rule-based reasoning logically different?

## Approaches to the modeling of case-based reasoning

Rule extraction method		Case comparison method	
(1) Extracting rules from decided cases		(1) Selecting relevant case facts	
(2) Showing that rule conditions are satisfied		(2) Establishing an analogy between cases	
(3a) Applying extracted rules to the case at hand	(3b) Pointing out exceptions to extracted rules	(3a) Following decided cases in the case at hand	(3b) Distinguishing decided cases from the case at hand

Roth 2003

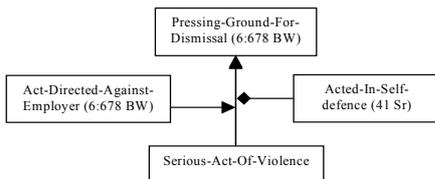
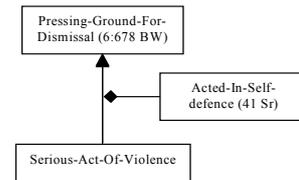
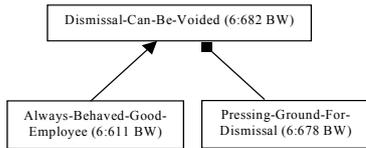
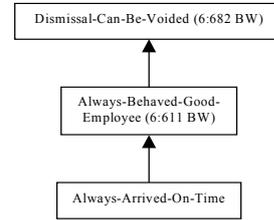
## Approaches to the modeling of case-based reasoning

Models of case-based reasoning  
*either*  
 focus on case comparison, but do not make explicit which conclusions could be drawn by following analogous cases  
*or*  
 focus on rule extraction, thereby obscuring the role of case analogy.

## Dialectical arguments and case-based reasoning

The present approach focuses on *case comparison* and makes explicit *which conclusions can be drawn* by following analogous cases.

Cases are compared in terms of the *dialectical arguments* that occur in them.



## Entangled dialectical arguments

Dialectical arguments can contain both reasons for and reasons against conclusions (internal conflicts).

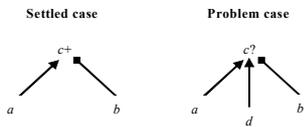
A statement can be supported or attacked by more than one reason (accrual).

It can be supported or attacked that a statement supports or attacks another statement (entanglement).

Cf. Verheij's DefLog (2003)

## Case comparison in terms of dialectical arguments

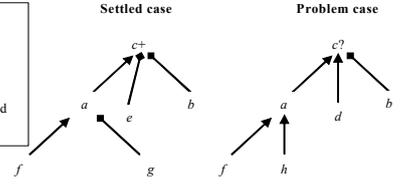
c: Dismissal-Can-Be-Voided  
 a: Always-Behaved-Good-Employee  
 b: Serious-Act-Of-Violence  
 d: Working-Atmosphere-Not-Affected



There is more dialectical support for *c* in the problem case, so *c* should follow by analogy with the settled case.  
 The same analysis can be done using Hypo's expressiveness.

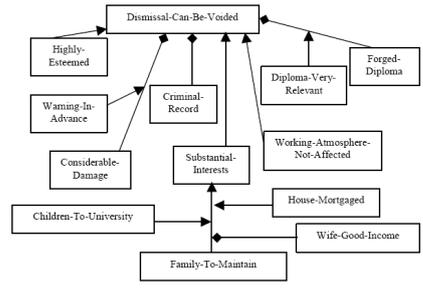
## Case comparison in terms of dialectical arguments

c: Dismissal-Can-Be-Voided  
 a: Always-Behaved-Good-Employee  
 f: Always-Arrived-On-Time  
 g: Once-Insulted-Superior  
 h: Always-Dressed-Propriety  
 b: Serious-Act-Of-Violence  
 d: Working-Atmosphere-Not-Affected  
 e: Criminal-Record



There is more dialectical support for the statement *a* in the problem case. There is more dialectical support for conclusion *c* in the problem case, so *c* should follow by analogy. (Note that we do not need to know whether *a* or not in the settled case.)  
 This extends Hypo's expressiveness.

## The entangled factor hierarchy

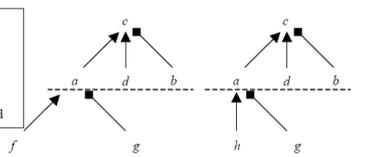


Roth 2003

## Factors and non-factors: the comparison basis

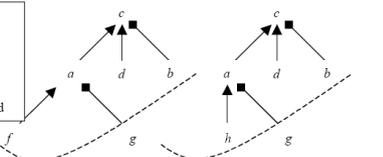
Comparison outcomes depend on the particular division made between factors and non-factors.  
 Arguing for a change of this division can downplay or emphasize distinctions.

c: Dismissal-Can-Be-Voided  
 a: Always-Behaved-Good-Employee  
 f: Always-Arrived-On-Time  
 g: Once-Insulted-Superior  
 h: Always-Dressed-Propriety  
 b: Serious-Act-Of-Violence  
 d: Working-Atmosphere-Not-Affected



Cases comparable

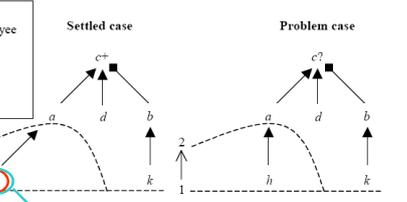
c: Dismissal-Can-Be-Voided  
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 g: Once-Insulted-Superior  
 h: Always-Dressed-Propriety  
 b: Serious-Act-Of-Violence  
 d: Working-Atmosphere-Not-Affected



Cases incomparable

## Downplaying a distinction

c: Dismissal-Can-Be-Voided  
 a: Always-Behaved-Good-Employee  
 f: Always-Arrived-On-Time  
 h: Always-Dressed-Propriety  
 b: Serious-Act-Of-Violence  
 k: Punched-In-Face  
 d: Highly-Esteemed



A significant distinction (comparison basis 1)

Not a significant distinction (comparison basis 2)

## Overview

Legal decision making

Case-based reasoning: Hypo

Case-based reasoning: entangled dialectical arguments

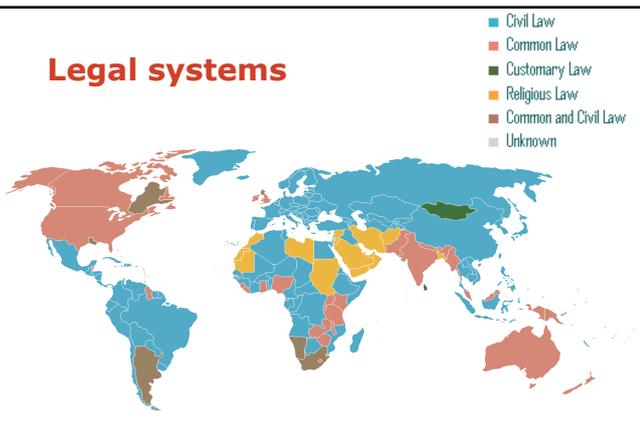
**Are case-based and rule-based reasoning logically different?**

## Rules and precedents

Rules and precedents as formal sources of law  
(Hart's rules of recognition)

Role depends on *jurisdictional sphere*

## Legal systems



## Rules and precedents

Comparative law research  
(MacCormick & Summers 1997):

- Rules and precedents are both significant sources
- This does not depend on whether precedents are officially considered to be formally binding

## Logical differences?

To what extent are there logical differences between the role of rules and precedents when deciding cases?

Is deciding cases logically different in a legal system with only rules and in one with only precedents?

Existing formal models seem to take the logical distinction for granted.

## Rule application

There is a rule with conditions A, B, C, ... and conclusion Z.

In the current case, the conditions A, B, C, ... are fulfilled.

THEREFORE

Conclusion Z follows.

## Precedent adherence

There is a precedent with A, B, C, .... as relevant factors for conclusion Z.

The current case matches the relevant factors A, B, C, ... of the precedent.

THEREFORE

Conclusion Z follows.

## Side comments

1. The technique used is that of semi-formal argumentation schemes
2. Schemes are defeasible
3. The schemes are not meant to be an absolutely correct/exact/unique representation
4. Scheme specification can be bent towards a context and goal

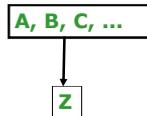
## Logically, the basic patterns are equal

A, B, C, ... --> Z

A, B, C, ...

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Z



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For more information on rules and principles, see:

Verheij, B., Hage, J.C., & van den Herik, H.J. (1998). An Integrated View on Rules and Principles. *Artificial Intelligence and Law* 6 (1), 3-26.

For more information on case-based reasoning with an entangled factor hierarchy, see:  
Roth, B. (2003). *Case-based reasoning in the law. A formal theory of reasoning by case comparison*. Dissertation Universiteit Maastricht.

Roth, B., & Verheij, B. (2004). Cases and Dialectical Arguments - An Approach to Case-Based Reasoning. *On the Move to Meaningful Internet Systems 2004: Otm 2004 Workshops, Proceedings (Lecture Notes in Computer Science, Vol. 3292)*, 634-651.

Roth, B., & Verheij, B. (2004). Dialectical Arguments and Case Comparison. *Legal Knowledge and Information Systems. JURIX 2004: The Seventeenth Annual Conference* (ed. Gordon, T.F.), 99-108. Amsterdam: IOS Press.

For more information on the relation between rule-based and case-based reasoning, see:

Verheij, B. (2008). About the Logical Relations between Cases and Rules. *Legal Knowledge and Information Systems. JURIX 2008: The Twenty-First Annual Conference* (eds. Francesconi, E., Sartor, G., & Tiscornia, D.), 21-32. Amsterdam: IOS Press.