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Reasoning by Analogy:
A Formal Reconstruction

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Abstract

In this paper we distinguish three logical reconstructions of reasoning by analogy in the law. The distinction between these logical forms is supported by our view on legal rules, goals and principles, and the relation between them. First, we present this view on legal rules and legal goals and principles. Second, we describe reasoning by analogy in terms of this view by means of examples. Finally, we show how these examples can be formally reconstructed in the logical formalism of Reason-Based Logic.
Keywords: Reasoning by analogy; legal knowledge representation; legal rules, goals and principles.

1 Introduction

This paper deals with reasoning by analogy in the law. We are, however, not interested in the precise nature of analogy; in particular we do not consider when cases should be considered sufficiently similar to justify reasoning by analogy.[1] Instead, we deal with the *logical reconstruction* of reasoning by analogy.

We consider cases of reasoning by analogy in which a legal rule does not apply directly, because its conditions are not (completely) satisfied, and distinguish three forms of reasoning by analogy:

- Application of general goals and principles that underlie the original legal rule that does not apply itself;

- Application of a specific principle the use of which is justified by more general goals and principles, which in their turn underlie the original legal rule that does not apply;

- Application of the original rule, but with a 'non-standard' justification of the application of the rule, based on, for instance, a principle.

In our view, there is no need to take the standpoint that only one of these forms tells what *real* reasoning by analogy is. Moreover, we do not pretend that all arguments of one of these forms are cases of reasoning by analogy. Our only claim is that many

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[1] This question is dealt with in, amongst others [Ashley, 1990; Yoshino *et al.*, 1993; Tiscornia, 1994].

examples of reasoning by analogy can be analyzed by means of these three argument forms.

To illustrate the differences between the forms, we will use one example, that is given three different logical reconstructions motivated by the three forms of reasoning by analogy.

In the next section we consider the relations between legal rules on the one hand, and legal goals and principles on the other hand. These relations support our view on reasoning by analogy. A discussion of the three forms of reasoning by analogy follows. Then we give an overview of Reason–Based Logic, a logical formalism that can deal with rules and reasons.[2] We sketch how the forms of reasoning by analogy can be formally reconstructed in Reason-Based Logic. The paper ends with a summary of the conclusions and some final remarks.

2 Legal rules and legal principles

Apparently two types of legal reasoning can be distinguished:[3]

- The application of legal rules.
  If there is a legal rule the conditions of which are satisfied, the rule is applied and its conclusion is derived.[4] The application of a legal rule seems to lead necessarily to its conclusion.

- The application of legal goals and principles.[5]
  If there is no legal rule that applies to a case, there can be a legal principle that leads to a reason for a conclusion. The application of a legal principle does not seem to lead directly to its conclusion. A conclusion follows only from all relevant reasons generated by applying principles.

These seem to be two fundamentally different types of reasoning. The difference appears most explicitly in the case of a conflict:

In case of conflicting legal *rules*, that is rules with incompatible conclusions that apply to a single case, the result will be a contradiction. To avoid such contradictions, the law knows several types of conflict rules: explicit priority clauses for pairs of rules, or for classes of rules, and implicit general rules such as Lex Superior, Lex Posterior, and Lex Specialis. Ideally these conflict rules make that only one of two incompatible rules actually applies, and in that way prevent the inconsistency from occurring.

In case of colliding legal *principles*,[6] i.e. if there are legal principles with incompatible conclusions that apply to a single case, no such problems occur. The application of

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[2]The theory of rules and reasons that underlies RBL is described in [Hage & Verheij, 1994a].

[3]The opposition of the two types of reasoning as described here, can be found in [Dworkin, 1978, pp. 24f].

[4]There can be complications: sometimes a rule is not applied, even though its conditions are satisfied, or a rule is applied, even though its conditions are not satisfied.

[5]In this connection, legally recognized goals, including policies, and values logically play the same role as legal principles. Cf. also [Dworkin, 1978, p. 22]. Where we discuss principles, we implicitly also refer to these goals.

[6]In the case of principles and reasons, we speak of collisions, rather than of conflicts, or contradictions. Colliding principles and reasons contribute together to the conclusion that will be drawn. It is not a matter of choice between incompatibles.

colliding principles only leads to reasons that plead for incompatible conclusions, so no contradiction is involved. In such cases, a collision can involve several distinct reasons, some of which plead for a conclusion, others against it. The relative weight of the reasons pro and the reasons con determines the final conclusion.

In our opinion, the difference between reasoning with legal rules and with legal principles is not so fundamental as might seem at first sight, and is rather a matter of degree.[7] Both application of legal rules and application of legal principles can be described as the generation of reasons. Both legal rules and legal principles, if they apply, generate reasons for their conclusions. The difference between legal rules and legal principles is that a legal rule, if it is applied, not only generates reasons for its conclusion, but also reasons against the application of other rules or principles. We call these latter reasons *exclusionary reasons*.[8] In this view, both legal rules and legal principles *only* generate reasons, and do not lead directly to their conclusions.

We illustrate this by considering a legal rule as the result of a *decision* of the legislator, taking into account several factors based on, possibly colliding, legal principles. We say that these legal principles *underlie* the legal rule. Moreover, the legal rule *replaces* the underlying legal principles (figure 1). This means that, if the legal rule applies, its underlying principles should not apply. Therefore, if a rule applies, it does not only generate a reason for its conclusion, but also exclusionary reasons that exclude the applicability of its underlying legal principles. In figure 1, the dashed boxes mean that the principles do not apply, while the closed box means that the rule applies.
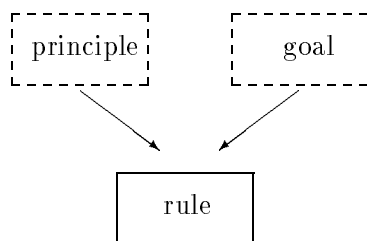

Figure 1: A legal rule replaces its underlying legal principles and goals

As our central example we take the legal rule from Dutch civil law that sale of a house does not terminate an existing rent contract (Art. 7A:1612 BW).[9] This rule has as its underlying goal that somebody who lives in a house should be protected against

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[7]Cf. the criticism by Alexy on Dworkin's account of the difference between legal rules and legal principles [Alexy, 1979]. Cf. also [Soeteman, 1991].

[8]Cf. Raz's theory about exclusionary reasons and their relation to mandatory norms [Raz, 1975, pp. 49f. and 85f.]. Although we adopt Raz's term, our account of exclusionary reasons differs somewhat from Raz's. According to Raz, exclusionary reasons are reasons not to act on other reasons, while in our view they are reasons not to apply rules or principles, with the effect that other reasons are not even constituted.

[9]This example was also discussed in [Prakken 1993, pp. 22–23]. Prakken gives the same phenomena a different interpretation, however. The approach taken by Prakken is briefly discussed in [Hage & Verheij, 1994a].

measures that threaten the enjoyment of the house, and as underlying principle that contracts only bind the contracting parties. The goal pleads against termination of an existing rent contract; the principle pleads for termination. By making the legal rule, the legislator has balanced this colliding goal and principle, and decided how the reasons generated by them should be weighed against each other. As a result, if the rule of article 1612 applies, this is a reason not to apply its underlying goal and principle anymore.[10]

In the terminology introduced above: The legal rule of article 1612 replaces the legal goal and principle dealing with the protection of house inhabitants and the binding scope of contracts. If the rule of article 1612 applies, it generates an exclusionary reason that excludes the applicability of the goal and principle. Only if the rule does not apply, its underlying goal and principle can be applicable.

3   Three forms of reasoning by analogy

In the introduction we have mentioned three forms of reasoning by analogy. In this section we elaborate them by means of an example. We assume that in a case of reasoning by analogy there is a legal rule the conditions of which are not satisfied. This rule is referred to as 'the original legal rule'. Because its conditions are not satisfied, the original legal rule does not apply directly. Nevertheless, its conclusion holds on another basis than standard rule application.

The rule of article 1612 says that the *sale* of a house does not terminate an existing rent contract. Reasoning by analogy, it can be argued that the *donation* of a house does not end an existing rent contract either. We show how this conclusion is justified in the three forms of reasoning by analogy. In all three forms, the underlying principle and goal[11] of the rule play a crucial role, which differs from case to case.

3.1   Application of underlying principles

In the first form of reasoning by analogy the principle and the goal that underlie the original legal rule are directly applied to the case.

The goal to safeguard the interests of the inhabitants of an house applies not only in a case of sale, but more generally in cases of transfer of the house, such as donation. The same holds for the principle that a third party is not bound by an existing contract. Therefore, in every case of transfer of a rented house, this principle and this goal lead to the *same* reasons pleading for or against the termination of the contract, as the reasons that were originally taken into account by the legislator, for cases of selling. As a result, the same outcome is justified, namely that the contract should not be terminated in cases of transfer of property.

So, instead of the original rule of article 1612, that does not apply, because its conditions are not satisfied, it is established which are the legal principles and goals underlying the rule, and then these are applied to the case in order to justify the conclusion not to terminate the contract (figure 2).

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[10]A constitutional argument for the same conclusion is based on the separation of powers. We think that there is a connection between the constitutional principle, and the role of exclusionary reasons in the law.

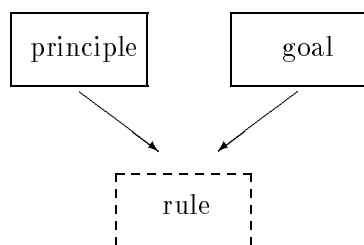[11]Scholten, who discusses this example [Scholten, 1974, p. 60], speaks of interests.

Figure 2: The principles and goals underlying the original rule apply

In this form of reasoning the same principle and goal apply as those replaced by the original legal rule. Such cases will often be of *the same kind* as those in which the legal rule applies, and therefore we can speak of a form of reasoning by analogy.[12] We summarize the first form of reasoning by analogy:

Form 1 *Reasoning by analogy is the direct application of general goals and principles that underlie the original legal rule.*

3.2 Application of a derived principle

The case of article 1612 can be analyzed in a different way. In this second form of reasoning by analogy, the validity of a specific legal principle is justified by the same goal and principle that led the legislator to make article 1612.

In other cases of the transfer of property, the factors underlying article 1612 apply just as in cases of selling. These factors (goals and principles) justify the adoption of the more specific principle that if the property of a rented house is transferred, the rent contract is to be continued with the new owner.

The adopted principle must be a principle, and cannot be a rule, because legal decision makers do not have the legal power to create rules. This power is necessary to be able to point out facts that will count as exclusionary, rather than ordinary, reasons.

The logical reconstruction is that the same legal goals and principles apply that justified the original rule. As a result, these same principles provide reasons that validate a more specific principle with the same conclusion as the original rule. Application of this more specific principle leads to a reason for the conclusion of the rule. Cf. figure 3.

We can speak of reasoning by analogy, because the specific principle is based on the *same* principles and goals as the original legal rule, and therefore applies to the same kind of cases. We summarize the second form of reasoning by analogy:

Form 2 *Reasoning by analogy is the application of a specific legal principle that is justified by the same principles and goals that also underlie the original legal rule.*

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[12]If only part of the underlying goals and principles apply, or more goals and principles are relevant, we cannot speak of a case of reasoning by analogy. The case might even be solved differently in these situations.
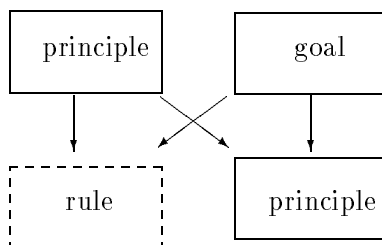
Figure 3: A principle applies that has the same underlying principles and goals as the original rule

3.3 Non-standard application of the original rule

We reconstruct the same example in a third way. In this last reconstruction, the original rule is itself applied although its conditions are not satisfied. There is, however, a non-standard justification to apply the rule.

The goal that somebody who lives in a house should be safeguarded against measures that threaten the enjoyment of the house provides us with a reason to take measures that safeguard the interests of the house's inhabitants. One way to achieve this goal is to apply the original rule of article 1612. Indeed, the standard reason for applying this rule are lacking in case the house is donated instead of sold, because the rule conditions are not satisfied. However, there can be other reasons to apply the rule. The legislator has made it possible to apply the rule of article 1612 in order to safeguard the inhabitants for the most frequent case (selling). A legal decision maker might decide to apply it in a non-standard case, such as transfer of property, also in order to safeguard the inhabitants.[13]

An obvious objection against the present reconstruction is that a rule can simply not be applied if its conditions are not satisfied. In our view, rule application is a form of acting, for which reasons for and against can be given. The satisfaction of a rule's conditions is a reason for application of the rule, but there can also be other reasons. An important source for such non-standard reasons is provided by the considerations that led the legislator to make the rule.

To summarize the third reconstruction of reasoning by analogy, it may be said that reasoning by analogy is to apply the underlying rule for the same reasons that motivated the legislator to make the rule. Notice that it is not the rule itself, but its application that is justified on the basis of these reasons. We summarize the third logical form of reasoning by analogy:

Form 3 *Reasoning by analogy is the actual application of the original rule, but with 'non-standard' justification of the application of the rule.*

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[13]Note that both the creation and the application of a rule are steps that are necessary to make a rule affect a particular case. The first is the task of the legislator, the second that of the legal decision maker.

4   Reason-Based Logic

As was already hinted at in the discussion of the third logical form of reasoning by analogy, the forms of reasoning by analogy that we distinguished presuppose a particular view of rule application, namely rule application as a form of acting. Reasoning about rule application has the application of a rule as its topic. Logically this means that rules figure in the object language as individuals, rather than as sentences. A further consequence is that reasoning with rules cannot be dealt with anymore by the rules of inference of classical logics such as sentential logic and first order predicate logic. We have developed a special logic,[14] based on the view of rules as generators of reasons for their conclusions, a logic in which the application of a rule is treated as a form of acting that can be argued for and against. This logic is called Reason-Based Logic (RBL).[15]

4.1   The language of RBL

The language of RBL is that of FOPL. Predicate symbols start with an uppercase letter, function symbols with a lowercase letter. To be able to refer to sentences as individuals, we use a naming convention: To obtain the term that corresponds to a formula, the first (uppercase) letter of each predicate symbol in the formula is replaced by the same letter in lowercase.[16] For example, the formula `Guilty(mary) & ~Punish(mary)` is referred to by the term `guilty(mary) & ~punish(mary)`.

The language of RBL has a number of special function and predicate symbols, that is `rule/3`,[17] `rule/1`, `Valid/1`, `Excluded/1`, `Applicable/3`, `Applies/3`, `Reason/3`, `{.,
., ..., .}/n` (for n = 0, 1, 2, ...), and `Outweighs/3`.

rule/3, rule/1   In RBL, rules are represented by *terms* of the language. In this way it
is possible to refer to them and to reason about them. A term denoting a rule has
the form:[18] `rule(id, condition, conclusion)`
Here `condition` is a formula of RBL and `conclusion` a literal of RBL. We assume
that `condition` is a disjunction of conjunctions of one or more literals.[19]   Each
disjunct of `condition` is a possible reason for `conclusion`. The first argument of a
rule, namely `id`, is called the identifier of the rule. It is assumed that in an RBL
theory (the set of sentences on which derivations are based) each rule has a unique

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[14]We use the word logic in a general sense: a logic is a formal model of reasoning.

[15]This section is largely taken from [Hage & Verheij, 1994a] and [Hage & Verheij, 1994b].   These papers treat RBL in more detail.

[16]The connectives of FOPL, e.g.   → and &, are treated as if they also are function symbols.   By overloading the notation, the translation of formulas to terms is as simple as mentioned. We do not use quantifiers in this paper. A universally quantified formula can be mimicked by a formula with free variables: a formula with free variables is considered as a scheme for its closed instances. An existentially quantified formula can be mimicked by replacing the existentially quantified variables by appropriate terms.

[17]The number following / denotes the arity of the function or predicate symbol.

[18]Metavariables for formulas will be denoted as strings of italic characters beginning with an upper case character, e.g., Atom. Metavariables for terms will be denoted as strings of italic lower case characters, e.g., atom. We use the convention that matching metavariables, such as Atom and atom, represent a formula and its corresponding term.

[19]If we speak informally of the conditions of a rule we mean these literals.   In formal notations we write condition (singular).

identifier. A term of the form `rule(id)` is used as an abbreviation of the term `rule(id, condition, conclusion)`. Because the identifier of a rule is unique, this does not lead to confusion.

Valid/1 The formula `Valid(rule(id))` means that the rule with identifier `id` is valid.

Excluded/1 The formula `Excluded(rule(id))` means that the rule with identifier `id` is excluded.

Applicable/3 The formula `Applicable(rule(id), facts, conclusion)` means that the rule with identifier `id` is made applicable by the facts denoted by the term `facts` and may generate a reason for the conclusion denoted by the term `conclusion`.

Applies/3 The formula `Applies(rule(id), facts, conclusion)` means that the rule with identifier `id` applies on the basis of the facts denoted by the term `facts` and generates a reason for the conclusion denoted by the term `conclusion`. The difference with the predicate Applicable is explained in the next section.

Reason/3 The formula `Reason(facts, atom, pro)` means that the facts denoted by the term `facts` are a reason for the conclusion denoted by the term `atom`. The formula `Reason(facts, atom, con)` means that facts are a reason against `atom`.

{., ., ..., .}/n (for n = 0, 1, 2, ...) These symbols are used to refer to sets of reasons. The term `{thief(mary), minor(mary)}` denotes the set of reasons that consists of the formulas `Thief(mary)` and `Minor(mary)`. The term `{}` (without arguments) is used to denote the empty set of reasons.[20]

Outweighs/3 The formula `Outweighs(reasons1, reasons2, atom)` means that the reasons in the set denoted by the term `reasons1` outweigh the reasons in the set denoted by the term `reasons2` (as reasons concerning `atom`). The terms `reasons1` and `reasons2` must both have the form `{facts1, facts2, ..., factsn}`, where n ≥ 0.

4.2 Inference in RBL

An RBL theory is a set of RBL formulas. The derivations from RBL theories are governed by the following seven rules.

Let T be an RBL theory.

R 1 *a. Any formula that can be derived from T in FOPL can be derived from T in RBL. b. Any formula that can be derived in FOPL from formulas that can be derived from T in RBL can be derived from T in RBL.*

Rule **R1** implies that the consequences of an RBL theory are deductively closed.

R 2 *Let* `Facts` *and* `Instance-of-conclusion` *be formulas such that 1.* `Facts` *is an instance of one of the disjuncts of the formula* `Condition` *under some substitution. 2.* `instance-of-conclusion` *is the instance of the term* `conclusion` *under*

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[20]There is a problem here with different terms that denote identical sets, such as thief(mary), minor(mary) and minor(mary), thief(mary). Axioms should be included in the theory of RBL such that formulas that only differ in such equivalent terms for sets are equivalent. We will not do this explicitly.

a. If `Valid(rule(id, condition, conclusion))`, `Facts` *and* ~`Excluded(rule(id))` *can be derived,*[21] *then* `Applicable(rule(id), facts, instance-of-conclusion)` *can be derived.*
b. If `Valid(rule(id, condition, conclusion))` *and* `Excluded(rule(id))` *can be derived, then* ~`Applicable(rule(id), facts, instance-of-conclusion)` *can be derived.*

Intuitively, **R2**a can be understood as saying that a valid rule is applicable if its conditions are satisfied, and if it is not excluded. **R2**b means that a valid excluded rule cannot be applicable. `Facts` stands for the facts that make the rule applicable. The definition is such that reasons based on rules with alternative conditions are always based on the satisfaction of one of the alternatives.

RBL does not define under which circumstances a rule is excluded. This has to be specified in the theory T. The default assumption is that a rule is not excluded. This is stated in rule bf R3:

R 3 *If* `Valid(rule(id,condition,conclusion))` *can be derived, and* `Excluded(rule(id))` *cannot be derived, then* ~`Excluded(rule(id))` *can be derived.*

R 4 *Let* `Atom` *be an atom of RBL. If* `Applicable(rule(id),facts,atom)` *can be derived, then* `Reason(facts,applies(rule(id),facts,atom),pro)` *can be derived.*

Intuitively this rule can be understood as saying that if a rule is applicable, the facts that make the rule applicable are a reason to apply the rule.

Notice the difference between a rule being applicable and it being applied (`Applies(rule(id))`). The former only indicates that there is a reason for the latter.

There can also be other reasons to apply a rule. For instance, if a case to which the rule is not applicable sufficiently resembles cases to which the rule is applicable, this may be a reason to apply the rule. In such cases we speak of *analogous application* of the rule. RBL does not indicate under which circumstances a rule should be applied analogously.

There can also be reasons against applying a rule. The circumstances under which such reasons occur have to be specified by the theory T.

R 5 *Let* `Atom` *be an atom of RBL.*
a. If `Applies(rule(id),facts,atom)` *can be derived, then* `Reason(facts,atom,pro)` *can be derived.*
b. If `Applies(rule(id),facts,atom)` *can be derived, then* `Reason(facts,atom,con)` *can be derived.*

Intuitively rule **R5** can be understood as saying that if a rule applies, the facts that make the rule apply are a reason for or against the rule conclusion, depending on whether the rule pleads for, respectively against the conclusion.

R 6 *Let* `Atom` *be an atom of RBL, let* `Reason(facts_pro1,atom,pro)`, `Reason(facts_pro2,atom,pro)`,..., `Reason(facts_pron,atom,pro)` *be all the reasons for* `Atom` *that can be derived, and let* `Reason(facts_con1,atom,con)`, `Reason(facts_con2, atom,con)`,..., `Reason(facts_conm,atom,con)` *be all the reasons against* `Atom` *that*

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[21] The word 'derive' means 'derive in RBL from T', if not otherwise specified.

can be derived.[22] *Let* `reasons_pro(atom)` *be an abbreviation of the term* {`facts_pro1,facts_pro2,...,facts_pron`}, *and* `reasons_con(atom)` *an abbreviation of* {`facts_con1,facts_con2,...,facts_conm`}.
a. If `Outweighs(reasons_pro(atom),reasons_con(atom),atom)` *can be derived in RBL, then* `Atom` *can be derived.*
b. If `Outweighs(reasons_con(atom),reasons_pro(atom),atom)` *can be derived in RBL, then* ~`Atom` *can be derived.*

Intuitively this rule says that a conclusion can be derived if the derivable reasons that plead for it outweigh the derivable reasons that plead against it, and that the negation of the conclusion can be derived if it is the other way round. If neither set of reasons outweighs the other set, nothing can be derived.

In general, the knowledge which set of reasons outweighs the other set should be provided by the theory T. However, in the case that all reasons point in the same direction, i.e., all reasons are either pros or cons, the following rule of inference provides the necessary weighing knowledge: any non-empty set of reasons outweighs the empty one.

R 7 *Let* `Atom` *be an atom of RBL, and let* `facts1, facts2, ..., factsn`, *where* $n \geq 0$, *be a series of conjunctions of literals. Then* `Outweighs(facts1,facts2,...,factsn, {},` `atom)` *can be derived in RBL.*

Unfortunately, the rules **R1** to **R7** above cannot be turned into an inductive construction of the set of formulas that can be derived from a theory T. This is due to the rules **R3** and **R6**, that both refer to the whole set of formulas that can be derived. **R3** requires that some statement cannot be derived, which can only be checked if we know everything that can be derived. **R6** makes use of all the reasons for and against a conclusion that can be derived from a theory T. The other properties only require that specific formulas can be derived.

A way to deal with this problem, based on Reiter's definition of an extension in default logic [Reiter, 1980] is described in [Hage & Verheij, 1994a; Hage & Verheij, 1994b].

5   A formal reconstruction

In this section we present formalizations in RBL of the examples of reasoning by analogy described before. Before discussing the forms of reasoning by analogy we describe how legal rules and legal principles can be dealt with in RBL.

5.1   Legal rules, goals and principles in RBL

In RBL, both legal rules, goals and principles are represented as RBL rules.[23] One of the essentials of RBL is that RBL rules, if they apply, only generate *reasons* for their conclusions. This is in accordance with what was said at the end of the section on

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[22] We do not consider the case that there is an infinite number of reasons.

[23] In a future version of RBL, there should be separate facilities to handle reasoning with goals. At present, reasoning with goals is reconstructed as reasoning with principles.

legal rules and principles, namely that in our view, legal rules, goals and principles only generate reasons, and that the difference between them is that a goal or principle can only generate a reason for its conclusion, while a legal rule can also generate exclusionary reasons that block the application of other rules, goals, and principles.

We return to the rule of 1612, that the sale of a house does not terminate an existing rent contract. In RBL, this rule can be represented by the following first order formula:

`Valid(rule(art1612bw, sale_house, continuation_contract))`

This formula means that there is a valid RBL rule with `Sale_house` as its condition,[24] and `Continuation_contract` as its conclusion. Notice that the rule is treated as a logical individual, that can be the subject of statements.

In RBL, rules have an identifier (a name), which for the present rule is `art1612bw`.

The goal to protect the interests of the inhabitants of a house underlies the rule of 1612. This goal can be represented as an RBL rule:

`Valid(rule(protection_inhabitants, protects_inhabitants(act), act))`

This RBL rule has as its condition `Protects_inhabitants(act)` and `Act` as its conclusion. The identifier is `protection_inhabitants`.

Suppose that in the case at hand a house was sold, and that the sale of a house is a kind of transfer of property. This can be represented by the following two sentences:

`Sale_house`

`Sale_house → Transfer_property`

If this were all we know, the RBL rules `art1612bw` and `protection_inhabitants` would both apply. However, as explained earlier, the rule of art. 1612 BW replaces its underlying goal. Therefore, in case the rule of art. 1612 BW applies, it excludes the applicability of the goal. In RBL this can be formalized as follows:

`Replaces(rule(art1612bw), rule(protection_inhabitants))`

```
Valid(rule(replacement,
           replaces(rule(id1), rule(id2)) & applies(rule(id1)),
           excluded(rule(id2))))
```

The first formula represents the fact that the rule of art. 1612 BW replaces its underlying goal. The second formula represents the rule that an applying rule that replaces another rule, normally excludes the application of that other rule.[25]

Because the condition of the rule is satisfied we can derive that the rule applies:[26]

`Applies(rule(art1612bw))`

As a result, the condition of the rule called replacement is satisfied by

`Replaces(rule(art1612bw),rule(protection_inhabitants)) &`

`Applies(rule(art1612bw))`

The conclusion follows that:

`Excluded(rule(protection_inhabitants))`

According to the rules of inference of RBL, an excluded rule normally does not apply.

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[24] RBL−rules only have one condition, that may be logically compound.

[25] Remember that rules include goals. The general rule about replacement and exclusion of goals and principles neatly illustrates the phenomenon of legal meta-knowledge, that was discussed in [Hage, 1990].

[26] We leave the steps that lead from the satisfaction of the rule conditions to the conclusion that the rule applies implicit. Moreover, in the formalism presented above, the predicate Applies has three arguments. We have omitted two of them for simplicity.

5.2   Application of underlying principles

Let us reconsider the first form of reasoning by analogy, and see how it is accounted for in RBL. To keep matters relatively simple, we will leave the principle that contracts only bind parties out of consideration.

As we have already seen, the legal rule and its underlying goal are represented by means of two RBL rules that are said to be valid.

`Valid(rule(art1612bw, sale_house, continuation_contract))`

`Valid(rule(protection_inhabitants, protects_inhabitants(act), act))`

In our example case, the house is not sold, but donated. Therefore, the conditions of rule art1612bw are not satisfied, and this rule does not apply. As a consequence, the application of the goal represented by the RBL rule `protection_inhabitants` is not excluded. Since continuation of the rent contract contributes to the realization of this goal, there is a reason to continue the contract:[27]

`Protects_inhabitants(continuation_contract)`

`Applies(rule(protection_inhabitants))`

`Reason(protects_inhabitants(continuation_contract),`

`continuation_contract, pro)`

Since there are no reasons against continuation of the contract (at least, that is what we assume), it can be derived that:

`Continuation_contract`

5.3   Validation of a more specific principle

One reason to adopt a particular principle in the law is that application of this principle to the suitable cases contributes to the realization of a legally recognized goal. In our example the interests of the inhabitants of the house can be protected by application of the principle that if the property of a house is transferred, the existing rent contract is continued with the new owner. This is a reason for the validity of that principle, by the rule `protection_inhabitants` above. In RBL this can be formalized as:

`Reason(protects_inhabitants(valid(rule(id,transfer_property,`

`continuation_contract))),`

`valid(rule(id, transfer_property, continuation_contract)),pro)`

This reason leads to the derivation of:

`Valid(rule(id, transfer_property, continuation_contract))`

Given the facts

`Donation_house`

`Donation_house → Transfer_property`

it can be derived that:

`Transfer_property`

This fact satisfies the condition of the newly derived rule (principle). Application of this rule leads to the conclusion that the rent contract is to be continued:

`Continuation_contract`

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[27]For simplicity, we use continuation_contract both as referring to a sentence and as referring to an action.

5.4   Non–standard application of a rule

In RBL, the application of a rule is a kind of acting. It is possible to adduce both reasons for and against the application of a rule. The normal reason for applying a rule consists of the facts that make the rule applicable, that is, the facts that satisfy the rule's conditions. Sometimes, however, there are other reasons to apply the rule. Such a reason may for instance be that the application of the rule contributes to a legally recognized goal:

```
Reason(protects_inhabitants(applies(rule(art1612bw))),
applies(rule(art1612bw)), pro)
```

If there are no reasons against the application of the rule, for instance reasons based on considerations of legal security, or if these counterreasons are outweighed by the reason to apply the rule, it can be derived that the rule applies:

```
Applies(rule(art1612bw))
```

If the rule applies, it generates a reason for its conclusion, and exclusionary reasons against the application of its underlying goal and principle. (Its underlying goal can of course still be applied to justify analogous application of the rule.)

6   Conclusion

In this paper we distinguished three forms of reasoning by analogy. This distinction was based on a particular theory about the relation between legal principles and goals on the one hand, and legal rules on the other hand. Legal rules replace their underlying principles and goals, and this is reflected in the logic of rule application, because rules not only generate reasons for their conclusions, but also reasons against the application of their underlying principles and goals.

Given our view on the relation between legal principles, goals and rules, it is possible to distinguish three forms of reasoning that can all be captured under the denominator of analogous reasoning. In the first form, the principles and goals that underlie the original legal rule are directly applied to the case, and generate reasons to solve the case in the same way as the rule would have solved it. In the second form, these same goals and principles generate reasons to adopt a more specific legal principle, which in turn generates a reason to solve the case. In the third form, the underlying goals and principles generate a non-standard reason to apply the underlying legal rule, which in turn generates a reason to solve the case.

Classical logics, such as sentential logic and first order predicate logic, are not very suitable to deal with these forms of reasoning. In particular it is necessary to both use and mention the rules, principles and goals that are involved in the legal argument, and to interrelate the results of arguments in which these rules etc. are mentioned and used. Classically this would amount to a confusion of object language and metalanguage. Moreover, the classical logics are not suitable to treat rule application as a kind of acting for which both reasons for and against can be adduced. We have shown that RBL, as an alternative for classical logics, provides the facilities to deal with all three forms of reasoning by analogy.

References

R. Alexy. Zum Begriff des Rechtprinzips. *Rechtstheorie*, Beiheft 1, p. 59–87.

K.D. Ashley. *Modeling Legal Argument: Reasoning with Cases and Hypotheticals.* MIT Press, 1990.

R. Dworkin. *Taking Rights Seriously.* Second edition, Duckworth, London.

J.C. Hage. Meta-kennis voor juridische kennissystemen. In *Proceedings NAIC '90*, 1990, pp. 299–308 (Dutch).

J. Hage and B. Verheij. Reason-Based Logic: a logic for reasoning with rules and reasons. To appear in *Law, Computers and Artificial Intelligence.* Published as report SKBS/B3.A/94-10.

J. Hage and B. Verheij. Towards a logic for reasoning with norms. In J. Breuker (ed): *Proceedings of the ECAI–94 Workshop on Artificial Normative Reasoning*, pp. 160–177. Also published as report SKBS/B3.A/94-12.

Henry Prakken. *Logical Tools for Modelling Legal Argument.* PhD thesis, Free University, Amsterdam, 1993.

J. Raz. *Practical Reason and Norms.* Hutchinson, London.

R. Reiter. A logic for default reasoning. *Artificial Intelligence*, 13:81–132, 1980.

P. Scholten. *Algemeen Deel van Mr C. Asser's Handleiding tot de beoefening van het Nederlands burgerlijk recht.* 3e druk, bewerkt door mr G.J. Scholten. Tjeenk Willink, Zwolle.

A. Soeteman. Hercules aan het werk; over de rol van rechtsbeginselen in het recht. In Dolman e.a. (eds.). *Rechtsbeginselen*, Ars Aequi, Nijmegen, p. 41–56.

D. Tiscornia. Three meanings of analogical reasoning in law. In *Proceedings of the Fourth National Conference on Law, Computers and Artificial Intelligence*, Exeter, 1994, pp. 137–153.

H. Yoshino, M. Haraguchi, S. Sakurai, and S. Kagayama. Towards a legal analogical reasoning system: knowledge representation and reasoning methods. In *Proceedings of the Fourth International Conference on Artificial Intelligence and Law*, ACM, 1993, pp. 110–116.

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