# Isomorphism and argumentation



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# Isomorphism and Argumentation

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## ABSTRACT

As knowledge representation tools become more sophisticated, and computer systems increase in power and ubiquity, the prospects of building practical applications based on the representation of large amounts of legislation draw closer. In this paper we reflect on our experience with developing a knowledge representation language for legal rules and an inference engine for this language in the Estrella project, in order to reconsider the principles which should guide the representation of legislation. One common demand, based largely on software engineering considerations relating to maintenance, verification and validation, is that representations should be *isomorphic* to their sources. We explore this notion by representing a fragment of German Family Law using our tools. We show that there are several different ways of representing even this small and simple fragment of law in an isomorphic fashion. Moreover these differences matter, in terms of where the burden of proof is allocated, in terms of the explanations produced, and in terms of the operational procedures that are reflected.

## 1. INTRODUCTION

Isomorphism has since the early nineties [11], [2] been seen as a desirable property of executable representations of law to be used in legal knowledge based systems. It has been seen as important for assuring the quality of legal knowledge based systems, especially to facilitate maintenance as the legislation is amended and to facilitate verification and validation. A similar approach, based on the notion of the *verbatim* representation proposed in [10] has formed the basis of the methodology of successful commercial developments by a company originally called Softlaw, later Ruleburst and later still Haley, and recently purchased by Oracle[1]. Other research projects which have given importance to isomorphic representation are the E-power project (e.g. [17]) and most recently, the Estrella project[2]. The Estrella project produced a formalism, the Legal Knowledge Interchange Format (LKIF), and a reference inference engine, explicitly designed to permit representations to be constructed, and reasoned with, as isomorphically as possible. LKIF allows for any combination of propositional connectives in the bodies of rules, allows for conditions to be categorised as assumptions and exceptions as well as standard conditions, and allows rules to be excluded by other rules. Output from the reference inference engine is in the form of an argumentation graph, showing what arguments can be put forward, and their status with respect to particular standards of proof. See [7] and [6] for more details. Several pilots were produced in the course of the Estrella project, and there is now an opportunity to reflect on the use of these facilities for isomorphic representation.

In this paper we will reconsider isomorphism, particularly in the light of the experience of the Estrella project. The paper will be structured as follows: section 2 will attempt to clarify the use of the term *isomorphism* in AI and Law, and identify the topics that we will address. Section 3 will introduce a sample piece of legislation, based on a translation of a fragment of legislation relating to German Family Law. Section 4 will consider a number of ways in which this legislation could be represented, and discuss the various pros and cons. Section 5 will offer some further discussion and concluding remarks.

## 2. ISOMORPHISM IN AI AND LAW

As used in AI and Law, isomorphism differs from standard mathematical usage – for a discussion of this see [12]. Perhaps the earliest use of the term *isomorphism* in AI and Law was in [11]. Karpf gave the following definition of what was intended by the term in this context:

> (i) Each legal source is represented separately.
>
> (ii) The representation preserves the structure of each legal source.
>
> (iii) The representation preserves the traditional mutual relations, references and connections between the legal sources.
>
> (iv) The representation of the legal sources and their mutual relations ... is separate from all other parts of the model, notably representation of queries and facts management.
>
> (v) If procedural law is part of the domain of the model then the law module will have representation of material as well as procedural rules and it is demanded that the whole system functions in accordance with and in the order following the procedural rules.

In [2] there was a somewhat more restricted notion, which is probably the sense in which it is now most widely used. Here

[1] www.haley.com/index.html
[2] http://www.estrellaproject.org/


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the emphasis is firmly fixed on the ability to determine dependencies and relationships between sections of the legislation, the legal source texts, and their representation in the knowledge base:

> The important demand made by isomorphism is that there is a clear correspondence between items to be found in the source material and items to be found in the knowledge base. The direction needed is this: that it is possible to say of any item in the knowledge base that it derives from some self-contained unit in the source material. Ideally there would be a one to one correspondence between the knowledge base items and the source material items, but practical reasons may necessitate deviation from this.

The reason for this emphasis was maintenance: when an amendment was made to the source, it was important to be able to identify, unequivocally with complete confidence, which item or items in the representation needed alteration. For example it might be that a concept such as *pensionable* age was defined in some section of an Act (say § 63) and subsequently used in a number of other sections. One way to do this would be to substitute the definition given in § 63 each time it was used. But if § 63 was subsequently changed (perhaps to equalise the pensionable age for men and women) this would require all the sections in which the original definition had been used to be identified and modified. In contrast if § 63 had been individually represented and then referred to in the other rules, a single change would have the correct effect, even without identifying the rules affected. This identification of source with representation had the additional benefit that knowledge drawn from one source could not be used to colour the representation of another. For example a term might be known to have been clarified in a commentary or judgement. As with a reference from the same source, that supplementary information should be represented as a separate item unfolding the term, rather than being substituted for it. Again this aids maintenance, for example if the clarifying ruling is subsequently overruled, and assists verification and validation since the representation can be considered solely by comparison with the original text, without the need to refer to other sections and sources.

These software engineering virtues are clear and proven, but are there other features which can be obtained by isomorphism? Points (iv) and (v) of the original definition in [11] seemed to refer not just to how the representation was to be be constructed, but how it would behave when executed. From the earliest days of AI and Law it has been noted that legislation is often structured as a general rule and then a number of specific exceptions. And for almost as long it has been argued that this is an important feature, which has consequences, and which should be preserved in an isomorphic representation of the legislation. At the First International Conference on AI and law it was argued in [5]

> The structuring of statutes as general rules with separate exceptions is common practice in legal drafting, and appears to serve a variety of purposes. General rules are shorter and easier to remember and apply. This facilitates the normative function of the law; the law would have little effect on social behavior if its rules were so convoluted that persons could only with great difficulty, if at all, predict the legal consequences of their actions. Generalized rules also permit persons to acquire quickly a superficial understanding of the law, and to deepen their knowledge gradually as the need arises. There are also basic economic considerations supporting this structuring of the law. Perfect information is not available to the courts or the parties about the relevant facts of a case. These facts need to be discovered, which usually entails considerable costs. A careful structuring of general rules and exceptions is one method of allocating the burden of proof,[3] which may be placed on the party for which it is expected that the relevant information is available at least cost.

Three points are made here: ease of application, ease of understanding, and the possibility of allocating the burden of proof. The last point was further supported later in [5] by discussing circumstances which allow some facts to be assumed in the absence of evidence to the contrary, a distinction also made in [13], where Sartor calls premises that must be shown *probanda*, and those that can be assumed until disproven *non-refutanda*. This third point is clearly important for the practical evaluation of particular claims, but equally the first two are more that simply a matter of aesthetics. If it is easier to apply and to understand the law presented in this fashion, then it will be easier to explain decisions, and for the explanations to be understood, in these terms also, and we might try to support this style of explanation in the way we represent our sources. It is these non-Software Engineering points in particular that we will explore through consideration of a number of possible representations of an example fragment of legislation. We introduce this fragment in the next section.

# 3. EXAMPLE: A FRAGMENT OF GERMAN FAMILY LAW

In this section we introduce the fragment of law we will use for our illustrative examples. It is taken from German Family Law and is intended to define when a family member is obliged to support another family member. The purpose of the benefit is to indicate that people in need of support should first look to family members for support, rather than the state. The relevant sections, translated into English are:

- 1589 BGB (Direct Lineage) A relative is in direct lineage if he is a descendant or ancestor. For example, children, grandchildren, parents, and grandparents are in direct lineage.
- 1590 BGB (Relatives by Marriage) There is no obligation to support the relatives of a spouse (husband or wife), such as a mother-in-law or father- in-law.
- 1601 BGB (Support Obligations) Relatives in direct lineage are obligated to support each other.
- 1602 BGB (Neediness) Only needy persons are entitled to support by family members. A person is needy only if unable to support himself.
- 1603 BGB (Capacity to Provide Support) A person is not obligated to support relatives if he does not have the capacity to support others, taking into consideration his income and assets as well as his own reasonable living expenses.
- 1611a BGB (Neediness Caused by Own Immoral Behavior) A needy person is not entitled to support from family members if his neediness was caused by his own immoral behavior, such as gambling, alcoholism, drug abuse or an aversion to work.

[3]The burden of proof intended here is what is now sometimes called the burden of persuasion. We will use burden of proof to mean burden of persuasion through out this paper.

- 1741 BGB (Adoption) For the purpose of determining support obligations, an adopted child is a descendent of the adopting parents.

- 91 BSHG (Undue Hardship) A person is not entitled to support from a relative if this would cause the relative undue hardship.

Three of these sections, 1589 BGB, 1741 BGB and 1590 BGB, are concerned with the notion of *direct lineage*. These are important for establishing the condition in 1601 BGB, but we will not consider them further. They have some interest in that they show how legislation can be used to clarify potentially doubtful issues, such as adoption and relation through marriage, and their numbering indicates that these definitions are from a different part of the Act.

1601 BGB then sets out the general principle that family members in direct lineage are obliged to support one another. 1602 BGB states an exception: there is no obligation to support family members who are capable of supporting themselves. Note that although this has the effect of an exception, it is in fact the typical case: most people through most of their lives are capable of supporting themselves. General legal rules do not express what, empirically, is normally or usually the case, but rather express a policy, based on values and goals, about how to behave, in general. In our example, the general policy is that family members should support each other. Criminal law expresses a policy against killing. Neither of these codes state anything about how often these things in fact happen.

The term *needy* might be considered open textured, but in practice it is equated to otherwise entitled to support through state benefits. The remaining sections state exceptions where the family member may be released from the obligation. 1603 BGB exempts people who do not have the capacity to support others. 1611a BGB says that family members may disqualify themselves from support through their own deprecated behaviour. The numbering suggests that this was an amendment. Typically people who bring their penury on themselves are disqualified from state benefits, and it was probably that the obligation which the state denied could not reasonably be imposed on family members. The final section, 91 BSHG, is from a different piece of legislation. It complements 1603 BGB. Whereas 1603 BGB excepts relatives from having to provide support if they are financially unable to provide support, 91 BSHG covers other kinds of hardships, such as the emotional hardship which would ensue if a woman were obliged to support a father who had abused her as a child.

# 4. STYLES OF REPRESENTATION

In this section we will will consider a number of styles of representation of these five sections. All of the examples are represented formally in the Legal Knowledge Interchange Format (LKIF), but displayed here using a more human-readable format which can be generated automatically from LKIF, which is an XML document type, using a Cascading Style Sheet (CSS).

## 4.1 Representation 1: Prolog-Style

We will begin with a traditional, Prolog-style, representation in which the five sections of the legislation are represented as conditions for the obligation to exist in a single rule in the knowledge base. This is not, of course, an isomorphic representation, since in brings together information from different sections, and even from different Acts. It will, however, provide a basis for comparison with later versions.

```
rule R1a.
  Person1 is obligated to support Person2
given
  all of the following are true:
    - Person1 is in direct lineage to Person2
    - assuming Person2 is needy
    - assuming Person1 has the capacity
      to provide support
    - unless Person2 is needy due to
      his own immoral behavior
    - unless  supporting Person2
      would cause Person1 undue hardship
```

There are a number of points to note here. In a typical Prolog representation, the negated fourth and fifth conditions in the body would be treated as negation as failure. This automatically puts the onus on Person1 to show that these conditions do in fact hold, otherwise it will be taken that they do not. This feature of Prolog representations was held up to be a positive advantage of Prolog representations in work such as [14]. Here we achieve this effect by modeling these two sections as *exceptions*, shown using *unless*. If, however, we did not want to allocate the burden, we are not forced to: by modeling these sections as standard premises, in this case negated premises, we could insist that they be shown, so that they become *probanda* instead of *non-refutanda*. Similarly we have marked the second and third conditions as assumptions, indicating that the burden of proof is on the proponent, i.e. the administrative clerk in our scenario, should these points be challenged. That we have made these four conditions assumptions and exceptions is to reflect the general condition (direct lineage) and exception structure of the legislation. The distinction between assumptions and exceptions allows us to say who needs to establish the various *non refutanda* should they become an issue, rather than relying on a general principle built into the language. How this flexibility as to who should have the burden of proof should be used, and whether its use is desirable, will be discussed in Section 5.1.

We will exercise our representations on an example case of Max, who is in direct lineage to Gertrude. Gertrude is needy, but Max lacks the capacity to support her. The argument graph for this example is shown in Figure 1.

In the figures, *acceptable* propositions, i.e. propositions which satisfy their standard of proof, are shown in boxes filled with grey. Propositions which are not acceptable are shown in white. The dialectical status of a statement, i.e. whether is has been questioned, accepted or rejected, is shown by prefixing the statement with a question mark (questioned), plus sign (accepted), negation sign (rejected), respectively. Statements which have not been brought into play by either side are unmarked. Arguments are displayed as circles. If an argument is *applicable*, i.e. if all of the premises of the argument *hold*, then the circle is filled with grey. Pro arguments are displayed with ordinary, filled arrowheads. Con arguments are displayed with open, white arrowheads. Ordinary premises are displayed with a solid line from the statement of the premise to the argument. Exceptions are displayed with dashed lines; assumptions with dotted lines. Negated premises are displayed with a crossbar (tee) on the line. Negation is an orthogonal property of premises; ordinary premises, exceptions and assumptions may all be negated.

The argument in Figure 1 is not applicable and thus shown in white, since the assumption regarding Max's capacity to provide support does not hold, because it has been rejected, as a fact, that Max has the capacity to provide support. Notice that the dialectical procedure of constructing *prima facie* arguments and then challenging them by asking critical questions provides us with the ability to explain negative conclusions, something which is not possible us-

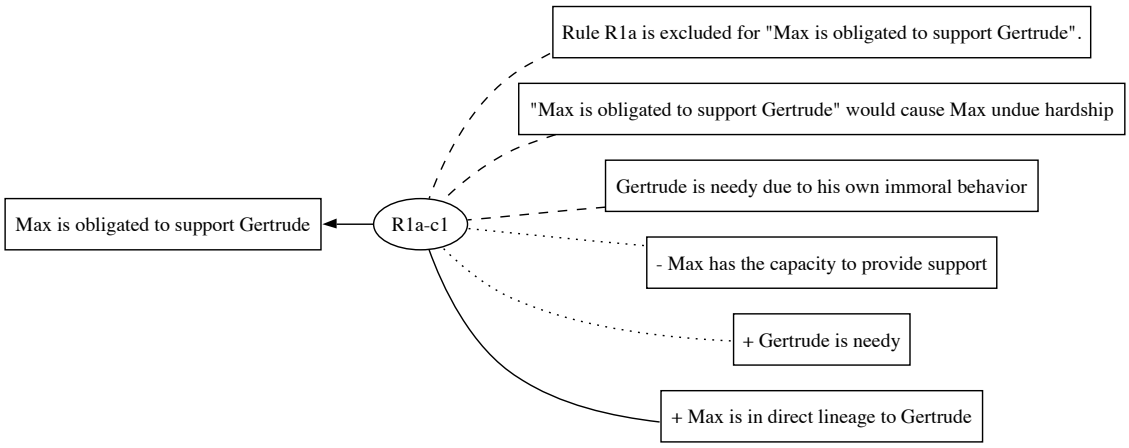


**Figure 1: Arguments from the R1 (Prolog-Style) representation**

ing Prolog: entering a query to Prolog using this representation would produce a bare 'no' with no explanation. The inability to explain why a conclusion does not hold is not very satisfactory: problems in explaining negative answers in such programs were often noted, e.g. in [1]. This is actually a significant problem with Prolog, since it does not enable any explicit explanation of why a person incapable of providing support is not obligated to provide support.

## 4.2 Representation 2: Conflicting Rules

Perhaps the most literal approach to isomorphism is simply to represent each section as a rule, with either the claim or its negation as head.

```
rule R2a.
  Person1 is obligated to support Person2
given
  Person1 is in direct lineage to Person2

rule R2b.
  it is not the case that:
    Person2 is obligated to support Person1
given
  it is not the case that:
    Person1 is needy

rule R2c.
  it is not the case that:
    Person1 is obligated to support Person2
given
  it is not the case that:
    Person1 has the capacity
      to provide support

rule R2d.
  it is not the case that:
    Person2 is obligated to support Person1
given
  Person1 is needy due to his own
    immoral behavior

rule R2e.
  it is not the case that:
    Person1 is obligated to support Person2
given
  Supporting Person2 would cause
    Person1 undue hardship
```

The argument graph for this representation and the Max-Gertrude case is shown in Figure 2. This presents a very different picture from the graph in Figure 1. Here we have three arguments, corresponding to the first three rules. The remaining two give rise to no arguments since their conditions are not satisfied. Two (shown with white arrowheads) are con the conclusion and one, with a black arrow head is pro. Note that one of the two con arguments (R2b-c1) is shown in white, since the negated premise does not hold, while the other (R2c-c1) is in grey because its negated premise does hold.[4] In this case the claim fails because it is not proven to the required standard.[5]

We can now see that this representation could be seen as improving upon the first one in three ways. First, there is no need to worry about how to allocate the burden of proof by classifying conditions as ordinary, assumptions and exceptions. Rather, there is a simple, universal principle: the person who makes a claim must prove all of premises of any argument constructed from a rule whose head matches the claim. Second, and more importantly, the argument graph constructed makes it easier to explain the result: the reasons why we might accept the claim, and the reasons why we should not accept it, are presented explicitly as conflicting arguments. In this case the proof standard of *dialectical validity* seems appropriate for resolving these conflicting arguments, but a court would be free to apply a different proof standard, if appropriate or required by law. Finally, whereas in Representation 1 the conflict between these arguments was resolved a priori by the knowledge engineer when representing the rules, Representation 2 allows the conflict to be resolved more flexibly, when deciding cases, taking into consideration their particular facts. Of course the knowledge engineer should consider whether this flexibility was intended by the legislature.

## 4.3 Representation 3: Using Exclusion

[4] A negated premise holds if and only if the statement of the premise is not accepted or acceptable, given its proof standard.

[5] We are using the standard of *dialectical validity*, which requires a justified pro argument and no justified con argument. Note that neither the conclusion nor its negation can be shown to this standard, which is why the burden of proof is so important.

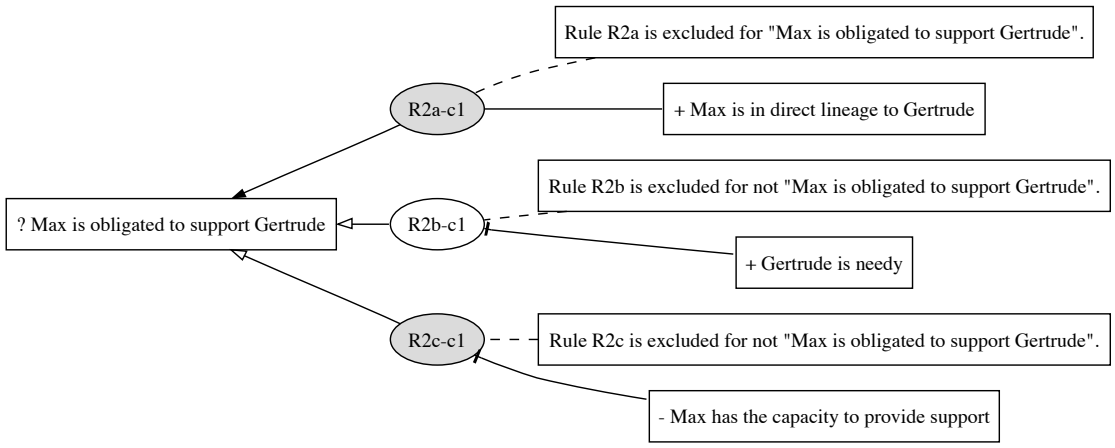


**Figure 2: Arguments from the R2 (Conflicting Rules) representation**

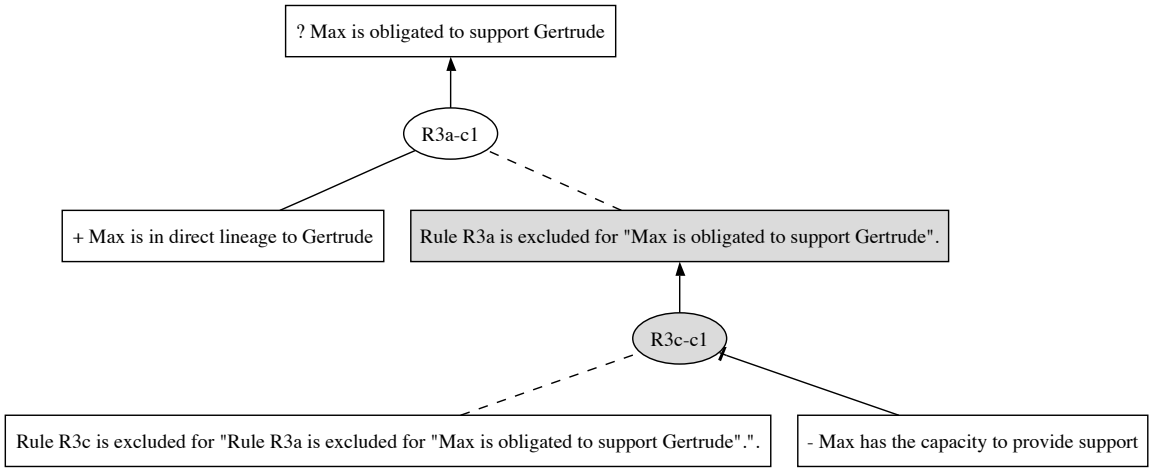


**Figure 3: Arguments from the R3 (Using Exclusion) representation**

Experience with the Estrella pilot studies showed that the experts who represented the various pieces of legislation seemed to prefer a representation in which there were not explicit arguments against a proposition, but rather rules which excluded other rules. This style is shown in Representation 3.

```
rule R3a.
  Person1 is obligated to support Person2
given
  Person1 is in direct lineage to Person2

rule R3b.
  R1 is excluded for
    "Person2 is obligated to support Person1"
given
  it is not the case that: Person1 is needy

rule R3c.
  R1 is excluded for
    "Person1 is obligated to support Person2"
given
  it is not the case that:
    Person1 has the capacity
      to provide support


rule R3d.
  R1 is excluded for
    "Person2 is obligated To support Person1"
given
  Person1 is needy due to his own
    immoral behavior

rule R3e.
  R1 is excluded for
    "Person1 is obligated to support Person2"
given
  "Person1 is obligated to support Person2"
    would cause Person1 undue hardship
```

Here the positive rule is the same as Representation 2, but the exceptions in the other four rules are now seen as excluding the application of this rule, rather than as reasons to believe the conclusion to be false. The corresponding argument graph for the Max-Gertrude case is shown in Figure 3. Now we get a deeper, but narrower argument graph with two rather than three arguments. Rule R3b does

not give rise to any argument since Gertrude is in fact needy, but Rule R3c now produces an argument which establishes the exclusion of R1. While Max is no longer able to explicitly argue that he has no support obligation, he can instead argue explicitly that rule R3a does not apply to him, and hence there are no grounds to suppose that he should be under such an obligation. The reason why he might be *prima facie* thought to be under the obligation is also shown. Compared with the graph of Figure 2, there is no mention of Gertrude's neediness. The implication of this is that this, like the absence of immorality, is assumed, unless shown otherwise, and thus need not be mentioned. Again the proof standard of dialectical validity is used. In this instance it would be possible to vary the standard both with respect to the argument based on R3a and that based on R3c, if there were good judicial reasons to do so.[6] To this extent the representation is more flexible.

An argument against Representation 3, from the isomorphic standpoint, is that the cross reference introduced in the rules is not justified by the wording of legislation. If the cross reference can be taken as implicit, this must be inferred from the order in which the sections are presented. In the original work on isomorphism the order of sections in the legislation was little discussed. The order of the clauses in Prolog programs, which determines the order in which clauses are tested and can therefore hide the existence of conflicting clauses was considered, but was felt to be a problem rather than a feature, and it was normally recommended the the effect of the Prolog clauses should be made independent of the order of execution, by including additional items in the body if necessary. But, if the order of the sections in the legislation is significant, and has a conventional interpretation that is agreed by legal experts, this should be reflected in the representation. If we can assume that such a convention exists, and the rules produced by the Estrella legal experts points strongly to such a convention, then we do need to reflect it in the representation, and the use of exclusions as in Representation 3 enables this. The emphasis on correspondence between sections of legislation and rules of the representation in traditional work on isomorphism may need to be extended to take note of such relations as well.

We may point to some further possible advantages. The absence of con arguments removes any temptation to think that Max should be presenting arguments that he is under no obligation to Gertrude until it has been suggested that he is. This more naturally reflects the operation of the law. Moreover, should Max be confronted with an argument suggesting that he is under this obligation he can counter not with a conflicting argument, which suggests the need for some resolution which may or may not be in his favour, but with a reason why that argument does not apply to him, avoiding the suggestion of conflict and the need for resolution. All this does seem more in accordance with the way in which we think of the law as operating, and further supports its attraction for our legal experts.

## 4.4 Representation 4: Mixed

Representations 2 and 3 went for a consistent approach to the four clauses representing exceptions: either all were represented as candidate con arguments, or all four were represented as excluding the general rule. But a mixture is possible, for example:

```
rule R4a.
  Person1 is obligated to support Person2
given
  Person1 is in direct lineage to Person2

rule R4b.
 R1 is excluded for
   "Person2 is obligated to support Person1"
given
  it is not the case that: Person1 is needy

rule R4c.
  R1 is excluded for
    "Person1 is obligated to support Person2"
given
  it is not the case that:
    Person1 has the capacity to provide support

rule R4d.
  it is not the case that:
    Person2 is obligated to support Person1
given
  Person1 is needy due to his own
    immoral behavior

rule R4e.
  it is not the case that:
    Person1 is obligated to support Person2
given
   Supporting Person2 would cause Person1
     undue hardship
```

Why might we want to adopt this approach? One argument would be that while R4a, R4b and R4c represent successive sections of the legislation, R4d is taken from a later block, and R4e from a different Act altogether. Thus it could be seen that the first three rules are connected, and so the implicit cross reference given by the order of the sections in the legislation can be legitimately inferred. These three sections taken together seem to express a piece of connected thinking – *a person should support their needy relatives if they can afford to do so* – in a way in which these other sections seem to represent quite separate issues. Moreover we could see these separate issues as requiring a different means of resolution. Verification of direct lineage and need, as given by qualification for state benefits, are simple administrative matters, as would be verifying a claim for exemption on the grounds of insufficient disposable income. Should, however, the capacity be shown, arguing for exemption of the grounds of the immorality of one's relative, or the possibility of hardship given the apparent capacity to meet the obligation on a simple calculation, would suggest some more rigorous resolution. The sections represented by R4d and R4e introduce distinct elements of open texture, and it might well be thought that a claimant who was unable to show that 1601 BGB did not apply to him in the normal way, should be required to propose explicit counter arguments which should be specifically, and judicially, resolved. Adopting Representation 4 would indicate what can be done routinely and what would need to be the subject to a more thorough procedure.

Using Representation 4 does not make any difference to Max and Gertrude in the circumstances we have been considering, as it yields essentially the same graph as Representation 3, because the factors treated differently in the mixed representation are not brought into play on these facts. To illustrate the differences we must therefore consider a different set of facts, so that the differently treated conditions are brought into play.

Suppose instead that Max does have the capacity to support Gertrude,

[6] This seems unlikely in this example, however, since dialectical validity is presumably the only reasonable standard for legal issues, as opposed to questions of fact requiring arguments from conflicting evidence to be aggregated.

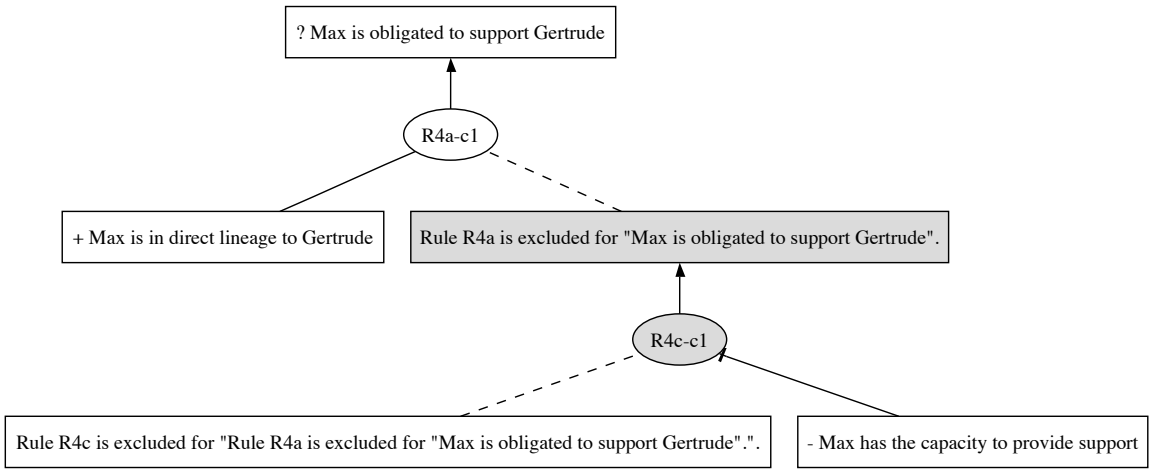


**Figure 4: Arguments from the R4 (Mixed) representation**

but that supporting her would cause him hardship. These new facts results in different argument graphs for the two representations, as illustrated Figure 5 and Figure 6. In these figures we have abbreviated the node labels for space reasons.

The graph for the mixed representation now clearly shows the conflicting pro and con arguments, where the con arguments appeal to particular personal circumstances. Note, however, by comparing Figure 6 with Figure 2, that in Representation 4 we are able to distinguish between 'normal' ways in which the obligation is avoided (lack of need or capacity) and 'special' ways depending on individual circumstances (immorality and hardship). These latter cases would probably need a finer grained resolution process before an arbiter capable of evaluating the particular case: it could be that dialectical validity is not the best standard to resolve the case here, although it is useful as a way of identifying a case in need of resolution, since neither the claim not its negation can be shown to meet this proof standard.

# 5. DISCUSSION

In the previous section we presented four different representations of our fragment of Family law. One of these was not isomorphic, but the other three could reasonably be said to be so. Certainly all of them satisfy the criterion of [2]. Interestingly, however, the different representations all gave rise to different behaviours and explanations. We will discuss three issues further: the desirability of allocating the of burden of proof in the representation, the need to group certain rules together, and the implications for the operation of a system based of these representations.

## 5.1 Allocating the Burden of Persuasion

The representation we have been using distinguishes ordinary premises from assumptions and exceptions. The justification for this distinction derives from the notion of argumentation schemes in informal argumentation theory. Although it was made as early as [3] for a full motivation of the distinction see [8]. The significance of this distinction is related to the burden of proof. Whilst an ordinary premise must be shown by the proponent, an assumption need be shown only by the proponent on demand, and an exception must be shown by the opponent. Ordinary premises and assumptions are *probanda* and exceptions are *non-refutanda* to use the terminology of [13], with the *probanda* distinguished into those which must always be shown and those which can normally be taken as read. The question is whether this is properly done *within* the representation, or whether this assignment of the burden of proof should always be left to a judge. We believe that it is proper to do this allocation in the representation, since in practice not every allocation of the burden of proof is the subject of dispute. It is, however, not always entirely clear from the wording how this should be allocated. The allocation in Representation 1 seems clearly right to us, and justifiable in terms of the wording. The two assumptions, if false, release a person from the obligation, whereas the two exceptions, if either is true, deny the person to be supported an entitlement. While, however, this gives us a rationale in this case, we would not argue that these linguistic clues would be available in every case. We use them to justify our *interpretation*, but it remains an interpretation. This emphasises the importance of the representation being done, or at least guided by, an expert in the specific legal domain.

## 5.2 Grouping Rules

As described in [2], isomorphism was concerned with structure at the section level, and paid little attention to relations between sections. But in any piece of legislation, the sections will necessarily appear in some order, and will be clustered together in some way. The element of ordering is taken into account in the move from our Representation 2 to our Representation 3, and the clustering of sections is taken into account in the move from our Representation 3 to Representation 4. Since there are significant differences between these three different representations, we would argue that this is a factor that needs to be considered. It may, of course, be that a legal expert would in practice prefer Representation 3 to Representation 4, and that our conjectures as to the differences that surface in Representation 4 should be suppressed rather than expressed. Which is the case, however, is not the point: the point is that it is possible to make these distinctions and so they need to be thought about carefully when the representation is done.

## 5.3 System Operation

Next we would like to consider the way the system is supposed to operate. Of course, this is rarely evident from the text of the legislation, but when legislation is conceived and drafted, particularly in the kind of routine procedures of public administration we have been considering, it is done so in the the light of some kind of system or process which will give effect to the law. One possible procedure for the administration of the law under discussion in this

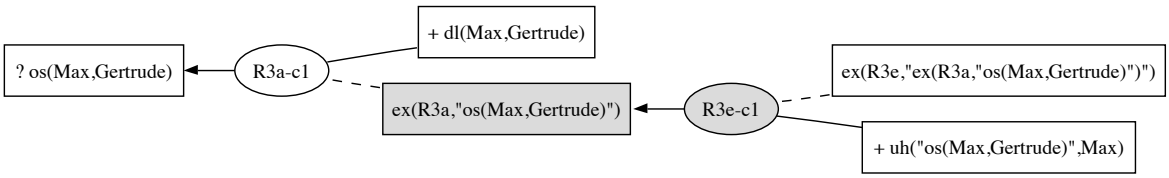


**Figure 5: Arguments from the R3 (Using Exclusion) representation, with other facts**

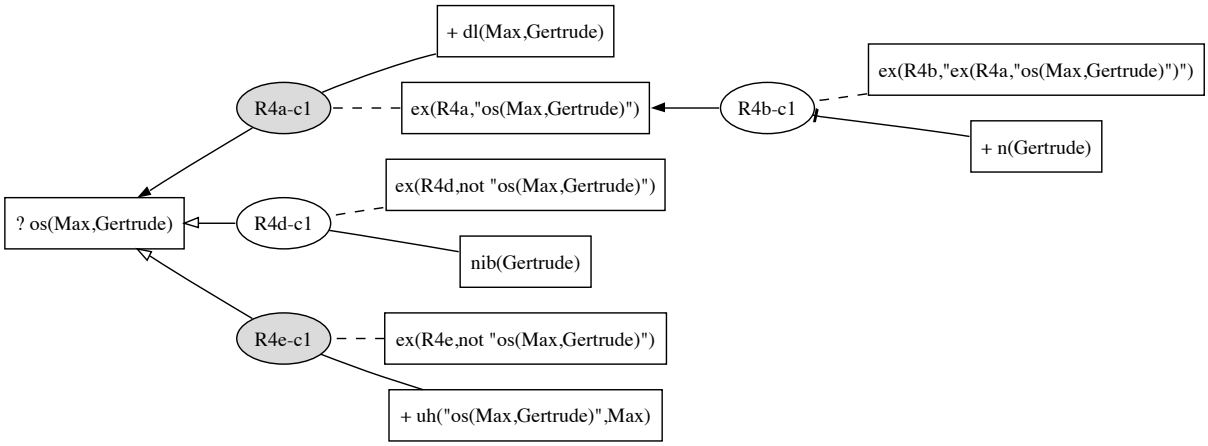


**Figure 6: Arguments from the R4 (Mixed) representation, with other facts**

paper could be as follows:

1. When a person becomes entitled to a benefit indicating that they are needy, a database query identifies relatives in direct lineage.
2. A letter is sent to the relatives so identified informing them of their general obligation to support their needy relative, assuming they have the capacity to do so. This letter will include a form for providing information about income, assets and living expenses, to be used to determine capacity, and informing them that they should make a statement of their financial circumstances if they wish to challenge the assumption of their capacity to do so.[7]
3. On receipt of the financial statement, the appropriate calculation of capacity is made and the relative is informed by letter of the administrative decision and the amount of support to be paid, if any.
4. The relative can challenge the administrative decision by claiming that the person's neediness was caused by his or her own immoral behaviour, or that paying support would cause undue hardship. This challenge may first be made by an internal administrative procedure, perhaps involving more senior staff, in which the relative presents his evidence of immoral behaviour or hardship.
5. If the agency stands by its initial decision, and does not accept the claims of immoral behaviour or undue hardship, the relative still has the option to appeal the decision to the courts.

[7]In practice this financial information might be needed even if capacity was unchallenged, for example to distribute the obligation to support across several family members. We will not, however, consider such complications here.

This fictive administrative procedure is intended to reflect the view expressed by Representation 4: Step 1 establishes the key *probanda* and assumes capacity. Step 2 offers an opportunity to challenge the assumption of capacity, and Step 3 determines whether the assumption was justified. Steps 4 and 5 give an initial, low cost, opportunity to provide and evaluate counterarguments, and Step 6 provides a more formal, and costly, procedure for resolving conflicts before a court, should the relative not agree with the analysis of the agency.

We would suggest that Representations 2 and 3 imply rather less satisfactory procedures. On Representation 2, all relatives in direct lineage would be issued with notification of their obligation and given four grounds to appeal against this. Representation 3 in contrast would need to handle not only the well defined notion of capacity but also the tricky notions of immorality and hardship in Step 3. Of course, the representation does not drive the process (rather the process should influence the representation), and use of Representation 2 could coexist with the six step process, but it is much more desirable that the representation be in harmony with what actually happens. Once more the crucial need to involve well informed experts in the representation process becomes apparent.

## 5.4 Role of Ontologies

When first introduced into AI and Law, ontologies were conceived of as specifying and controlling the vocabulary to be used in writing rules, e.g [4]. This followed very much the original conception of Gruber [9]. Where systems were developed from legislation, it was considered important to develop the ontology from an analysis of the legislation to insure a principled relation between the language of the legislation and the language of the rule base [18]. At that time description logics were in their infancy, although some broader conception of the role of ontologies was envisaged in work such as [15]. Since then, however, the ability to use description

logic to compute results from ontologies has increased so that now there are practical theorem provers available, such as Pellet.[8] This has led to the notion that an ontology could be used directly as the knowledge representation of a legal expert system being revived, most recently in the Harness system [16], also developed as part of the Estrella project. It is worth briefly discussing this approach here.

The key idea of Harness, which was already present in [15], is that normative knowledge is expressed as a generic case description, together with a deontic qualification. Isomorphism would be supported in this approach by relating the case descriptions to legislative clauses. In [16] the deontic qualifications used are *allowed* and *disallowed*. Applied to our fragment of Family Law, this might yield (in a very much simplified, ad hoc notation) the following:

```
Gc1: in-direct-lineage(Person1, Person 2),
     not support(Person1, Person2)
     => disallowed.
Gc2a: in-direct-lineage(Person1, Person2),
      not support(Person1, Person2),
      not needy(Person2)
      => allowed.
Gc2b: in-direct-lineage(Person1, Person2),
      not support(Person1, Person2),
      not has-capacity(Person1)
      => allowed.
Gc2c: in-direct-lineage(Person1, Person2),
      not support(Person1, Person2),
      immoral(Person2)
      => allowed.
Gc2d: in-direct-lineage(Person1, Person2),
      not support(Person1, Person2),
      undue-hardship(Person1)
      =>  allowed.
```

Here Gc2a-d are more specific descriptions than Gc1, and so represent a set of exceptions to the general norm expressed in Gc1. Just as with rules there are a variety of alternative ways of representing the legislation. For example:

```
Gc0: in-direct-lineage(Person1, Person2),
     not support(Person1, Person2),
     => allowed.
Gc1: in-direct-lineage(Person1, Person2),
     not support(Person1, Person2),
     needy(Person2)
     => disallowed.
Gc2b: in-direct-lineage(Person1, Person2),
      not support(Person1, Person2),
      needy(Person2)
      not has-capacity(Person1)
      => allowed.
Gc2c: in-direct-lineage(Person1, Person2),
      not support(Person1, Person2),
      needy(Person2)
      immoral(Person2)
      => allowed.
Gc2d: in-direct-lineage(Person1, Person2),
      not support(Person1, Person2),
      needy(Person2)
      undue-hardship(Person1)
      => allowed.
```

[8]http://clarkparsia.com/pellet/

Here Person 2 being not needy is taken as the standard case Gc0, with Gc1 a specialisation giving rise to the obligation and Gc2b-d being more specific situations releasing Person 1 from the obligation. The existence of these alternatives suggests that this style of representation also requires expert consideration of the messages the legislation was intended to convey, and issues such as clustering and ordering. Moreover the notion of more specific case descriptions is likely to have implications for the process of information gathering, even though it is unclear as to who has the responsibility for determining that none of the more specific descriptions apply.

The ontology representation is most similar to our Representation 2: each of the more specific case descriptions provides an argument to defeat the *prima facie* expressed in Gc1. There are, however, differences. First, the more specific case description is always followed: thus the resolution of the conflicting arguments is determinate. Second, it can be shown that there is no obligation, whereas in Representation 2 neither obligation nor no obligation could be shown to the proof standard of dialectical validity. Third, it is not clear to whom the obligation to avoid the violation applies. In Gc1 there is violation but this could be escaped either by Person1 supporting Person2, or by Person2 getting a job, and so moving to Gc2a. Finally the distinction between assumptions and exceptions does not appear, and so there is no allocation of burden of proof. It is argued in [16] that the Harness approach permits the use of "a decidable formalism that seems sufficiently expressive to represent a large portion of existing legislation". This is something that is yet to be demonstrated in practice, but in any case we would suggest that it offers less freedom to incorporate within the representation resolutions to the kinds of issues that motivated the choice between our various isomorphic representations. In particular it does not provide the knowledge engineer the tools needed to model the legislation isomorphically, while at the same time preserving the distribution of the burden of proof and the distinctions between the various kinds of burden of proof. In contrast, the rule-based representation represents the burden of questioning through assumptions and the burden of persuasion through ordinary premises and exceptions, which allocate the burden of persuasion to the different parties. Nor does the ontology representation provide the means for different explanations, or to reflect the process used to decide the claims in practice. Of course, it could then be argued that the last two points are task-dependent and the representation should be kept as free as possible from such task-dependent notions. We, however, see some advantages in permitting the representation to fit the task, provided that the knowledge engineer does indeed have a clear concept of the task which it will support.

# 6. CONCLUDING REMARKS

In this paper we have considered implications of isomorphic representation which go beyond the standard Software Engineering concerns, and which raise issues of system behaviour and explanation. Now that tools for building Legal Knowledge Based systems have attained a greater degree of sophistication and there is some real prospect of representing large-scale systems in practice, these issues have taken on new importance. We have offered some different ways of representing a simple fragment of legislation which highlight the choices that need to be made when building the represention, and some of the effects and significance of those choices. Representing legislation will never be a mechanical process, and will always require interpretation against the context of applicable legal conventions, and the way in which the legislation will be applied in practice.

# 7. ACKNOWLEDGMENTS

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