Proceedings of the Federated Conference on Computer Science and Information Systems pp. 393–402
DOI: 10.15439/2016F272
ACSIS, Vol. 8. ISSN 2300-5963

Modeling conflicts between legal rules

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***Abstract*—The main aim of this work is to formalize the mechanism of resolving conflicts between statutory legal rules with a view to implementing them into a legal advisory system. The model is build on the basis of the *ASPIC*$^+$ argument modeling framework. The paper presents a discussion and a formal model of the mechanism of conflict recognition as well as models of three different mechanisms of conflict solving and a discussion of the relations between them.**

I. Introduction

TYPICAL rule-based expert systems reasoning mechanisms require knowledge bases which are created upon a few spoken and unspoken features and assumptions, such as the closed world assumption, the lack of inconsistencies and circularities in the knowledge base, etc. All of these features allow for the utilization of simple and fast modus ponens-based forward and backward chaining mechanisms. Unfortunately, there are numerous expertise areas for which many of these assumptions cannot be implemented.

One of these areas is law. There certainly have been some experiments whose authors attempted to create legal expert systems, but only a very narrow portion of statutory administrative law appears suitable for implementation in a legal expert system [1], [2]; most of these implementations have also been widely criticized [3]. The main problem of the utilization of classical expert systems in legal expertise lies in the specificity of legal knowledge and a significant presence of commonsense knowledge in legal reasoning. Additionally, legal knowledge (and commonsense knowledge connected with it) very often cannot fulfill the above-mentioned features and assumptions of a properly constructed knowledge base: legal knowledge can be inconsistent, conflicting, imprecise, and there may always appear new circumstances which may change case evaluation. Law is not a perfect and complete system. Legislators cannot foresee all possible situations which should be regulated by law; legal norms may be conflicting, they may lead to unfair conclusions, they require interpretation because it is unclear if the conditions are satisfied, etc. All these reasons hinder the simulation of legal reasoning and creation legal expert systems. A number of models of legal reasoning allowing for the representation of some aspects of legal expertise have been developed, but none of them can be regarded as complete. Practical experience reveals that legal reasoning often makes use of very "peculiar" means of inference, going far beyond the standard modus ponens principle employed in expert systems. Most of these methods are very challenging to formalize; they also are defeasible and do not guarantee correct conclusions. On the basis of the above one may notice that modeling inference processes as performed by lawyers can be perceived as a way to create an advisory legal system. The range of issues connected with modeling legal reasoning includes the problem of resolving conflicts between statutory legal rules. Legal theory and practice have worked out some methods of resolving such conflicts, yet many of them are based on commonsense knowledge, which is extremaly difficult to formalize.

The main aim of this work is to formalize a mechanism of resolving conflicts between statutory legal rules with a view to implementing it into a legal advisory system. Another aim is to incorporate the model into *ASPIC*$^+$, one of the most comprehensive argumentation modeling frameworks, thanks to which the model can be applied to a wide range of real-life legal cases.

In order to create such a model as accurately as possible, it is necessary to make some assumptions. The first one is connected with focusing on statutory legal rules. Many authors (e.g. [4]) point out important distinctions between legal principles and legal rules, where principles are statements which may be applied to various degrees (especially in the case of a conflict), but rules may be either applied or not. If there is a conflict between two or more rules, only one of them may be applied; if there is a conflict between two or more principles, the degrees of how much each may be applied are weighted. In this work I am going to focus on resolving conflicts between legal rules only. The second assumption stems from the fact that to provide a legal opinion, a lawyer usually requires not only legal knowledge (legal rules, principles which are taken from statutes), but also commonsense knowledge and knowledge about mechanisms of legal interpretation and reasoning. In order to simulate such a process as accurately as possible, it is indispensable to make a clear-cut distinction between the provision itself, its interpretation, inference mechanisms, as well as commonsense knowledge required to implement legal provisions. This distinction would allow for preserving both the universal character of the provision and its applicability to various legal problems. The third assumption is connected with the second one: the model should precisely represent the wording of the legal act and as such should contain any provision-specific imperfections, including imprecision, undefined assumptions, loopholes, ambiguity, etc. Inference and interpretation engines should be endowed with mecha-

978-83-60810-90-3/$25.00

nisms allowing for overcoming legal knowledge imperfections. Such procedures should mirror mechanisms which are used by human lawyers in such situations.

Legal theory and practice worked out a group of mechanisms which allow for resolving conflicts between rules. Most of these methods are independent of the circumstances of a given case, yet one of them is based on commonsense relations between conflicting rules and another is based on the axiological estimation of a case. It is important to notice that conflicts may appear not only between literal interpretations of statutory norms. Legal theory says that such conflicts may appear between norms reconstructed by the utilization of any inference rules (per analogiam, a'fortiori, etc.) or interpretation mechanisms.

There are four methods of conflict solving:

- *lex superior derogat legi inferiori*,
- *lex posterior derogat legi priori*,
- *lex specialis derogat legi generali*,
- an axiological method: *argument from social importance*.

The methods do not have equal power: the weaker one is used only if the stronger one does not allow for solving the conflict. The first three methods will be discussed in section III but the fourth (and the weakest) one is presented and modeled in [5], hence the model of the argument from social importance will not be presented here, though it can be easily adopted into the model presented in this paper.

II. The notion of conflict between legal rules

In legal theory there are numerous doubts about the problem of deciding who is able to state the existence of a conflict between legal rules. This is also the crucial aspect of this study.

A. The notion of conflict in the literature

A detailed discussion of the problem of the notion of conflict between legal rules is presented in [5].

Usually, a conflict between the rules of the law is treated as a clash between two distinct arguments (or their subsets) leading to two mutually exclusive conclusions [6], [7], [8]. In [9] rules are deemed conflicting when one of them "attacks" the other one, i.e. when the conclusion of one rule is complementary to the conclusion or condition of the other one. The conflict model proposed by J. Hage [10] is relatively complex. It is based on the assumption that a conflict occurs only if the conclusion from one rule implies A and the conlusion from the other one implies non-A, though it may result from the commonsense-based limitations related to the circumstances analyzed. Comparing the model of conflict from [10] (Chapter 5 concerning the rule coherence) to other models presented in [7], [8], and [11], the author points out, inter alia, that the source of conflicts may not stem only from the complementary nature of the conclusions (P and non-P, referred to as a logical conflict), but also from the incompatibility of the factual states they describe. The compatibility (or incompatibility) of the factual states may be evaluated through additional constraints (the rules may be incompatible with respect to certain constraints) and rules, which may come from commonsense knowledge.

In my opinion the key point of the discussion of the problem of conflict between statutory legal rules lies in the impossibility to detect such a conflict without considering arguments in which such rules appear. Legal rules very seldom exist separately since they are usually used as a part of the whole argument in which other kinds of rules (mainly commonsense ones) also appear. I believe that a real conflict between rules can be discovered by taking into consideration the whole argumentation process.

One of the most recent and important approaches to modeling legal argumentation is *ASPIC*$^+$ presented (among others) in [12]. *ASPIC*$^+$ is a complete framework allowing for the modeling of legal argumentation, one of whose elements is a model of the relation of an attack of one argument on another. The issue of attacks on arguments was described in [13]. The authors of the paper distinguish and define three ways by which one argument can attack another: An undermining attack is an attack on the premises of an argument, an undercutting attack is an attack on the inference step and is a way to provide "exceptions to the rule," and finally, a rebutting attack is performed by constructing a contrary or contradictory conclusion for an attacked argument's (sub)conclusion.

This definition allows for a distinction between direct and indirect attacks: an argument can be indirectly attacked by directly attacking one of its proper subarguments.

The attack relation tells us which arguments are in conflict with each other: if two arguments are in conflict, then they cannot both be accepted. The resolution of such a conflict requires the declaration of additional knowledge. The authors of [12], [13], like many others, assume a binary ordering $\prec$ on the set of all arguments that can be constructed on the basis of the argumentation theory. On the basis of such orders, they define a relation of defeat:

- A successfully rebuts B if A rebuts B on B' and $A \not\prec B'$;
- A successfully undermines B if A undermines B on φ and $A \not\prec \varphi$;
- A defeats B iff A undercuts or successfully rebuts or successfully undermines B;

where A, B, B' are arguments, φ is a one of the premises of argument B.

The issue of conflicts in a knowledge base appears not only in legal decision support systems. For example, the authors of [14] discuss the mechanism of conflict detection in business intelligence systems.

B. *ASPIC*$^+$ argumentation framework

Since the *ASPIC*$^+$ framework is a very powerful and useful tool for legal argumentation modeling, I am going to build the model of legal rules' conflict resolution on the basis of this framework. An *ASPIC*$^+$ based model of conflict detection is presented in [5]; here I am going to sketch a few important aspects of the model.

Due to the length limitation, *ASPIC*$^+$ will not be presented here in detail. I am only going to discuss some basic defini-

tions, which may lead to a better understanding of my idea; a more detailed discussion of the framework can be found in [12], [13], and others.

Generally speaking, *ASPIC*$^+$ is a framework for structured argumentation representation. It is important to emphasize that it is not a system but a framework for specifying systems, hence it does not specify any logical language to represent arguments.

ASPIC$^+$ allows for the definition of the specific logical language $\mathscr{L}$ for the representation of an argument. Arguments are constructed from a knowledge base [12], [13]:

A knowledge base in an argumentation system is a pair $(K, \leq')$ where $K \subseteq \mathscr{L}$ and $\leq'$ is a partial preorder on $K \backslash K_n$. Here $K = K_n \cup K_p \cup K_a \cup K_i$ where these subsets of K are disjoint and there are (unattackable) premises called necessary axioms (K_n), (attackable) ordinary premises (K_p), assumptions (K_a) – which are a weak type of premise always defeated by an attack – and issues (K_i) which are premises that are not acceptable unless backed by further argument.

Below are presented some basics of the framework:

An *argumentation system* is a tuple $AS = (\mathscr{L}, \mathscr{R}, n)$, where [12]:

- $\mathscr{L}$ is a logical language closed under negation;
- $\mathscr{R} = \mathscr{R}_s \cup \mathscr{R}_d$ is a set of strict ($\mathscr{R}_s$) and defeasible ($\mathscr{R}_d$) inference rules of the form $\phi_1, ..., \phi_n \rightarrow \phi$ and $\phi_1, ..., \phi_n \Rightarrow \phi$, respectively (where ϕ_i, ϕ are meta-variables ranging over wff in $\mathscr{L}$) and $\mathscr{R}_s \cap \mathscr{R}_d = \emptyset$;
- n is a naming convention ($n : \mathscr{R} \rightarrow \mathscr{L}$).

An argument in *ASPIC*$^+$ is one of the following constructs:

- ϕ if $\phi \in K_n \cup K_p$;
- $A_1, ..., A_n \rightarrow \psi$ if $A_1, ..., A_n$ are arguments, $Conc(A_1), ..., Conc(A_n) \rightarrow \psi$ is a strict rule in $\mathscr{R}_s$ and $Conc(A_i)$ is a conclusion of an argument A_i;
- $A_1, ..., A_n \Rightarrow \psi$ if $A_1, ..., A_n$ are arguments, $Conc(A_1), ..., Conc(A_n) \Rightarrow \psi$ is a defeasible rule in $\mathscr{R}_s$, and $Conc(A_i)$ is a conclusion of an argument A_i;

A structured argumentation framework (*SAF*) is a triple $\langle \mathscr{A}, \mathscr{C}, \preceq \rangle$ where [12]:

- $\mathscr{A}$ is the smallest set of all finite arguments constructed from a knowledge base in AS;
- $\preceq$ is an ordering on $\mathscr{A}$;
- $(X, Y) \in \mathscr{C}$ iff X attacks (is in conflict with) Y.

ASPIC$^+$ is also meant to generate abstract argumentation frameworks in Dung's understanding [15]. Such frameworks are simply directed graphs in which arguments (nodes) are related to other arguments by attack or defeat relations (arcs).

C. Model of conflict of legal rules

The most important assumption is a clear-cut distinction between legal rules and ordinary commonsense rules. Only the authors of [16] present an approach to formalize legal norms in *ASPIC*$^+$, yet they miss the problem of conflicts between norms; also, their formalization of legal rules is different from the one presented in this paper. Distinguishing between legal and commonsense rules is important for several reasons: firstly, a model of statutory legal norms should mirror the wording of a legal act as precisely as possible and, secondly, the defeaters of legal rules should be, and usually are, precisely regulated by law. Therefore, they cannot be treated in the same way as ordinary commonsense arguments.

On the basis of the above we assume that a set $K_p \in K$ (ordinary premises) consists of two sets: K_l and K_c, where K_l is a set of legal knowledge and K_c is a set of commonsense knowledge. K_l and K_c are separate: $K_l \cap K_c = \emptyset$.

Since a conflict may appear between legal rules, we have to allow to add to a set K_l legal rules in the shape:

$r : Conditions \twoheadrightarrow c$

where *Conditions* is a formula whose satisfaction causes truthfulness of a conclusion c. The binary connective $\twoheadrightarrow$ is used to represent a legal rule, since K_l is in K_p, the legal rule can be defeated by other argument. The defeasibility characteristic of a legal rule differs from ordinary commonsense rules. For example, the authors of [12] discuss a new connective $\rightsquigarrow$ in $\mathscr{L}$ in which $p \rightsquigarrow q$ stands for *"if p then normally/typically/usually q."* Such a rule differs from the legal one in a few important points: firstly, a legal rule is valid not only "usually" or "typically," but it is valid constantly until it is defeated. Secondly, the defeating mechanism of a legal rule is, in opposition to an ordinary commonsense rule (like $p \rightsquigarrow q$), precisely regulated by law and there is no other way to defeat it.

Since we are going to solve the problem of conflict between legal rules, we have to define what is understood as a conflict between legal rules: The authors of *ASPIC*$^+$, on the basis of their previous works, identify three kinds of attack relation on an argument [13]: undercutting, rebutting, and undermining. Since undermining concerns an attack on a premise of an argument, it cannot be treated as an attack on a legal rule.

Undercutting and rebutting concern attacking an argument or its conclusion and if both conflicting arguments use legal rules (from a set K_l), then there may be a conflict between legal rules. If an undercutting attack concerns an inference step based on a legal rule from a set K_l or a rebutting attack concerns a (sub)conclusion of a legal rule and an attacking argument uses at least one legal rule, then there is a conflict between legal rules. More formally, legal rules $r_1, r_2 \in K_l$ are potentially conflicting if:

- A undercuts argument B (on B'), r_1 is used in argument A, r_2 is used in the top rule of B' and $r_1 \neq r_2$ (r_1 and r_2 are different).
  or:
- A rebuts argument B (on B'), r_1 is used in argument A, r_2 is used in argument B' and $r_1 \neq r_2$ (r_1 and r_2 are different).

Without an in-depth analysis of the context and meaning of both arguments, it is very difficult to recognize beyond doubt whether such a conflict exists between legal rules or other subarguments. It is important to notice that conflicting legal rules do not have to be top rules of both arguments (A and B'), except undercutting argument B', because such an attack should strictly address a rule which should be defeated. It is

much easier to discover such a conflict in the special situation when conflicting legal rules r_1, r_2 are the only defeasible rules in both arguments:
Legal rules $r_1, r_2 \in K_l$ are in conflict if:

- A undercuts argument B (on B'), $Defrules(A) = A_l$, argument $r_1 \in Prem(A_l)$, $r_1 \in K_l$, there are no other defeasible rules in A, $Defrules(B') = B_l$, $r_2 \in Prem(B_l)$, $r_2 \in K_l$, $r_1 \neq r_2$ and r_2 is the top rule of B'.
- A rebuts argument B (on B'), $Defrules(A) = A_l$, $r_1 \in Prem(A_l)$, $r_1 \in K_l$, there are no other defeasible rules in A, $Defrules(B') = B_l$, $r_2 \in Prem(B_l)$, $r_2 \in K_l$, $r_1 \neq r_2$ and there are no other defeasible rules in B'.

Where: $Prem(A)$ is a function which returns the premises of an argument (by $r \in Prem(A)$ we denote that a rule r is one of the premises of argument A), $Defrules(A)$ is a function which returns defeasible inference rules used in argument A.

It is important to notice that there will be a conflict between legal rules even if the attack relation is not symmetrical (argument A attacks argument B and argument B does not attack argument A). By $conflictingRules(A,B)$ we denote that two arguments A and B contain conflicting legal rules.

III. Methods of conflict resolving between legal rules

Although in this work I am going to focus on the Polish legal system, the mechanisms which are described here may be adjusted to other statutory law systems in a relatively easy way.

At the beginning we have to look at the problem of conflict resolution from a more general point of view. If we have recognized that there is a conflict between two (or more) legal rules and we know that we cannot overcome the conflict by reconciling the conflicting norms using other legal norms, then we have to use one of the conflict resolution methods. All of these methods work in a similar way: in the case of a collision between legal rules, on the basis of some reasons listed below it is recognized which of the conflicting rules has a higher priority and all conflicting rules with lower priorities are then excluded from the reasoning process.

The theory of law distinguishes 4 main ways of resolving conflicts between legal rules [17]:

1) *Lex superior derogat legi inferiori*, based on the structural nature of law, where every legal act has its own position in the hierarchy. If one of the conflicting norms comes from the act which is at a higher position in the hierarchy, then such a norm prevails over the one from the act which is at a lower position in the hierarchy.
2) *Lex posterior derogat legi priori*, based on the time of establishing a given legal act. A legal act established later prevails over an act established earlier.
3) *Lex specialis derogat legi generali* in which a specific act (provision) derogates from (prevails over) a general regulation.
4) The final and most controversial method, known as an argument from social importance, where a rule which is more important from the axiological point of view prevails over a less important one.

Ad 1. Discussing the problem of hierarchy between legal norms requires some consideration of legal norms form several points of view:

a the first one is based on a strict hierarchy of legal acts,
b the second one is based on the relation between general law and internal law,
c the third one is based on the relation between a law which binds over the whole country and a law which binds over a part of the country,
d the fourth one is based on the relation between national and international law.

ad [a] From the point of view of the strict hierarchy of legal acts, we may state that in Polish law the constitution prevails over a legal act, which prevails over a regulation (where a regulation is a normative act issued on the basis of a specific authorization contained in a legal act aiming to allow for the execution of the act).

ad [b] From the point of view of conflict between general and internal law, the theory of law states that general law prevails over internal law.

ad [c] From the territorial point of view, a law which binds over the whole country prevails over a law which binds over a part of the country.

ad [d] Relations between national and international law are not the topic of this paper because we are going to discuss only the relations between the norms of national law.

Ad 2. The *lex posterior* mechanism of conflict resolution is based on the analysis of the dates when legal acts were established: an act established earlier has a lower priority than an act established later. If there is a conflict between these acts, the second one prevails over the first one. It is important to notice that such a mechanism works only if both conflicting acts are at the same level in the hierarchy and it is not possible to determine whether either is more specific. In other words, the *lex posterior...* mechanism has a lower priority than *lex superior...* or *lex specialis...* and it can only be employed if the utilization of *lex superior...* or *lex specialis...* cannot resolve the conflict.

Ad 3. *Lex specialis derogat legi generali* is a principle under which a specific act (provision) derogates from (prevails over) a general regulation. This mechanism is based on the analysis of the scope of conflicting legal rules and it allows for resolving conflicts which may appear, unlike in *lex posterior* or in *lex superior*, between the rules from the same legal act. This is a very strong mechanism which should be used very carefully because it may even change the conclusion made on the basis of the *lex superior* principle. There is a problem of superiority of *lex superior* over *lex specialis* of which legal literature does not include a clear view. In general, *lex superior* prevails over *lex specialis* (for example in [18] it is stated that *lex superior* is absolutely valid) but sometimes it may not work (following [17]): a legal act (as a more specific one) may be an exception to a constitutional norm or a local law (as a more

specific one) may prevail over a national one. Unfortunately, [17] does not explain clearly when or in what conditions such exceptions may occur.

Ad 4. An argument from social importance is the most controversial one and it should be used only if other ways of conflict resolution do not allow for resolving an existing conflict. This mechanism is based on the distinction between axiological contexts of conflicting norms. One of the norms may be more significant from the point of view of social importance and this norm should prevail over the less significant one. Unlike the abovementioned mechanisms, this mechanism is based on reasons which come from outside the law, making it more difficult to justify and apply. One of the main problems connected with this conflict resolution method is the uncertainty of interpretation and evaluation of social importance. One of the most clear (though rather seldom) situations may appear when one of the conflicting norms is strictly based on an expressly stated legal principle, which clearly states this norm's social importance. In other situations it is very difficult to undoubtedly decide which of the analyzed norms is more significant from the point of view of social importance. This is the reason why such a method is used very seldom and usually only in higher courts. It is also important that an argument from social importance can be strengthened by supporting it by previously decided cases. A detailed discussion and the model of an argument from social importance can be found in [5].

IV. Model of conflict resolution

Since I am going to model conflicts between legal rules, it is necessary to make some assumptions with regard to modeling such rules. In order to keep the model simple, I am going to represent them using the propositional logic, but it is also possible to use more expressive logics (the example presented in the section VI will be extended with deontic modalities) as well as additional interpretation mechanisms (for example teleological, like in [19]) and inference mechanisms (like a'fortiori [20] or instrumental [21]). The utilization of such mechanisms is important because in the literature [17] it is emphasized that such conflicts may appear between the norms reconstructed by the utilization of any inference rules (per analogiam, a'fortiori, etc.) or interpretation mechanisms.

At the beginning we have to assume some elements of a language $\mathscr{L}$ which will allow for the representation of legal rules. We assume a set of operators $OP \subset \mathscr{L}$, where $OP = \{\neg, \sim, \vee, \wedge, \twoheadrightarrow, \supset\}$ which will be used to model legal rules.

- $\neg$ is classical (strong) negation;
- $\sim$ is negation as failure;
- $\vee$ is a disjunction;
- $\wedge$ is a conjunction;
- $\twoheadrightarrow$ is a binary connective which stands for a defeasible legal rule;
- $\supset$ is a classical (material) implication used in commonsense rules.

A language $\mathscr{L}$ can also include other operators (defeasible implication, etc.) which should allow for a more adequate representation of various kinds of commonsense arguments. Let $F = \{f_1, f_2, ...\}$ be a set of propositional atoms called facts. We assume that a legal rule is a formula in the form:

$$r_n : Conditions \twoheadrightarrow Conclusion;$$

where:

- n is a rule's name
- *Conditions* is a (possibly empty) antecedent formula;
- *Conclusion* is a rule's non-empty conclusion in the form: $Conclusion = (lx \wedge ly \wedge \ldots)$, where: lx, ly are atomic conclusions which can be positive (f) or negative facts (negated by classical negation only $\neg f$).

An antecedent formula is a formula: $c1$ ***func*** $c2$ ***func*** $\ldots$ cn, where ***func*** are the operators from the set $\{\vee, \wedge\}$ and $\{c1, c2, \ldots, cn\}$ are atomic conditions, each being either a positive fact(f) or one negated by classical negation ($\neg f$), negation as failure ($\sim f$), or both ($\sim \neg f$).

Legal reasoning uses various interpretation and reasoning mechanisms; however, the legal literature points out that the basic one is linguistic interpretation (a more detailed description of linguistic interpretation can be found in [19]). As an unstrict way satisfying a rule's antecedent we understand the satisfaction of a rule's condition by utilizing any non-standard (non-linguistic) interpretation mechanism, e.g. teleological (an example of a model of teleological interpetation can be found in [19]), systematic, etc. A detailed discussion of the issue of modeling legal interpretation can be found in [22], [23], and [24].

By $K \bullet Conditions$ we will denote that a knowledge base K satisfies the conditions of a given legal rule.

On the basis of the above, a new defeasible inference rule should be added to a set $\mathscr{R}_d$:

$$r_n : Conditions \twoheadrightarrow Conclusion \wedge K \bullet Conditions \Rightarrow conclusion$$

Most authors working on modeling the resolution of conflicts between legal rules assume the existence of an order between rules or prioritising them ([9], [7], [1], [10], [25], etc.). Such an order allows to decide which of the conflicting rules is strongest and prevails over the weaker ones. Unfortunately, in real-life situations it is difficult to assume in advance that one rule is always stronger than another. It usually depends on many circumstances, which are sometimes difficult to express. To overcome this disadvantage, G. Sartor and H. Prakken ([9], [25]) propose defeasible priorities and rules which allow for inference about priorities.

A. Model of lex superior...

An interesting model of *lex superior...* is presented in [26], where the authors treat the level of authority which establishes a norm as a root of preference between norms. Unfortunately, such a conception does not fit the Polish legal system in which the hierarchy of legal acts is not strictly based on authority hierarchy, but is established by legal theory.

The *lex superior...* principle is based on a hierarchy of norms. It is obvious that formalization of a legal norm should

represent the meaning of this norm in a most accurate way, with all its features and imperfections. If we try to reconstruct the content of a legal rule from a legal text, it is important not to forget that not only the strict wording of the norm is important. There is also some relevant information connected with the norm from which a given legal rule comes from, like the position in the legal system, the date of issue, etc. Since the model of the *lex superior...* principle requires information about the position of the analyzed norms in the legal system hierarchy, such information has to be added to our model.

Let us assume that there are 2 conflicting legal rules:

$$r_1 : Conditions1 \twoheadrightarrow Conclusion1$$
$$r_2 : Conditions2 \twoheadrightarrow Conclusion2$$

It is clear that we have to add some information about the source of the rule, on the basis of which we can conclude the hierarchy between rules. We have three main levels of the legal norms hierarchy: the constitution, a legal act, and a regulation; however, apart from the general, national law there are other acts: internal legal norms, local norms, norms whose scope is narrowed to some parts of the country, etc. As $HCH \in K_n$ we denote a set of the levels of a hierarchy ($HCH = \{hch_1, hch_2, \ldots\}$). A strict partial order $OH = (HCH, >_{hch}) \in K_n$ represents a hierarchy of norms. A set $ACT = \{act_1, act_2, \ldots\} \in K_l$ represents a set of all statutory legal acts. Let an act $act \in ACT$ be a set of legal rules. By $r_l \in act_x$ we denote that a legal rule r_l is taken from an act act_x. A function $H : ACT \to HCH$ assigns to a given legal act a hierarchy level.

Every act belongs to only one hierarchy level. By $H(act_n) = hch_m$ we denote that act_n belongs to hierarchy level hch_m.

If we recognize r_n and r_m as conflicting rules, then we can solve the conflict using the *lex superior...* principle $lexSuperior \in \mathscr{R}_d$:

$$lexSuperior : (r_n \in act_k) \wedge (r_m \in act_l) \wedge (H(act_k) = hch_x) \wedge (H(act_l) = hch_y) \wedge (hch_x >_{hch} hch_y) \wedge (r_n \in Prem(A)) \wedge (r_m \in Prem(B)) \Rightarrow A \succeq B$$

where A, B are arguments built on conflicting legal rules. If both of the arguments attack each other (rebut or undercut) and it is possible to conclude (on the basis of *lexSuperior*) an order $A \succeq B$, then argument A defeats argument B.

B. Model of lex posterior...

The *lex posterior...* principle is in some points similar to *lex superior...*: both of them are also based on the properties of legal acts from which the conflicting rules are taken. While *lex superior...* is based on the position of a statute in the legal system, *lex posterior...* is based on the date of issue of a statute. If we have two conflicting rules issued on different dates, then, on the basis of the *lex posterior...* principle, a rule issued later prevails over a rule issued earlier. Similarly to *lex superior...*, we have to rely on a specific feature of acts from which conflicting rules are taken.

Let us assume that we have 2 conflicting legal rules:

$$r_1 : Conditions1 \twoheadrightarrow Conclusions1$$
$$r_2 : Conditions2 \twoheadrightarrow Conclusions2$$

By $DATE \in K_n$ we denote a set of all dates of issue of all legal acts. A function $D : ACT \to DATE$ assigns date of issue to a given act. By:

$$D(act_m) = date_m$$

we denote that a norm included in act_m was issued on date $date_m$. A strict order between the dates of issue of norms $OD = (DATE, >_{time}) \in K_l$ reflects the later-sooner relation. By $date_m >_{time} date_n$ we denote that $date_m$ was earlier than $date_n$.

If we recognize r_n and r_m as conflicting rules, then we may solve the conflict using the *lex posterior...* principle ($lexPosterior \in \mathscr{R}_d$):

$$lexPosterior : (r_n \in act_k) \wedge (r_m \in act_l) \wedge (D(act_k) = date_k) \wedge (D(act_l) = date_l) \wedge (date_k >_{time} date_l) \wedge (r_n \in Prem(A)) \wedge (r_m \in Prem(B)) \Rightarrow B \succeq A$$

where A, B are arguments built on conflicting legal rules. If both of the arguments attack each other (rebut or undercut) and it is possible to conclude (on the basis of *lexPosterior*) an order $B \succeq A$, then argument B defeats argument A.

C. Model of lex specialis...

Since *lex superior...* and *lex posterior...* are based on the knowledge which comes from legal sources, their models do not require any external sources of knowledge. Unlike them both, the *lex specialis...* principle is based on commonsense knowledge, which makes modeling this method much more challenging, because the representation and collection of commonsense knowledge is still one of the most complicated and difficult problems in the field of artificial intelligence.

Lex specialis... in the literature:

The *lex specialis...* principle has been mentioned in many papers concerning the problems of defeasible reasoning, argumentation, or normative conflicts, but in most of these papers the authors do not make attempts to formalize its nature. They usually assume an order declared in advance, which represents a relation of generality. Only in [27] a model of such a mechanism is presented:

A *normative position np* in an activity state q is more specific than np' (denoted as $np \succ_S np'$), if $np \in N_q$ and $np' \in N_q^{in}$, where: *normative position* is a deontic state of activity, N_q is a set of normative positions of an activity state q, and N_q^{in} is a set of normative positions propagated from a state of a super activity to an activity state q.

Unfortunately, it is unclear what the authors of the paper understand as a relation of activity – super activity. It may be understood as a superclass – subclass relation or an aggregation (a super activity consists of activities). Following the example presented in the paper, the relation should be understood as a kind of aggregation. It is, in my opinion, an oversimplification of the problem because not every relation

of being more or less specific can be described in such a way. I believe that such a way of modeling is appropriate for only relatively small and well-structured cases like, for example, small multi-agent systems (for which the model described in [27] was designed). Real-life legal cases are usually too fuzzy and ambiguous to let us assume without any doubt that activity q_1 is a super activity to q_2.

The model presented in [27] is an interesting approach to discuss *lex specialis...*, but due to the abovementioned controversies, I am going to present my own version of the formalization of the principle, disregarding the already assumed relations of inheritance between activities.

The model

From the model presented in [27] we adopt the idea of utilization of a partial order representing the relation being more or less specific, but its origin will be different than in [27].

Let $SPEC = (K_l, >_{spec})$ will be a partial order representing a generality relation between legal rules.

Let us assume two conflicting legal rules:

$$r_1 : Conditions1 \twoheadrightarrow Conclusion1$$

$$r_2 : Conditions2 \twoheadrightarrow Conclusion2$$

We have to decide which of them is more specific. What does it mean? As stated earlier, this mechanism is based on the analysis of the scope of conflicting legal rules. A rule which is more specific (for example, r_1) regulates a group of cases which is a subgroup of cases regulated by a more general rule (for example, r_2). Basing on the above, we may state that the scope of a rule depends on the conditional (left-hand) part of the rule, because the decision which case can be classified within the range of the scope of the rule is based on this part of a given rule.

The issue of modeling of *lex specialis...* can be divided into two separate tasks: the first one is to recognize which (if any) of the rules is more specific; the second one is to model the process of defeating a more general rule. Firstly, I am going to focus on the first task and to look at the problem of *lex specialis...* from a purely theoretical point of view. If we are going to model the principle, then we have to investigate if a set of cases which satisfies the conditions of one of the conflicting rules subsumes a set of cases which satisfies the conditions of another one. More formally, the condition of subsumption of a rule's antecendent can be modeled in such a way:

Where $Conditions1$ and $Conditions2$ are antecedents of the conflicting rules, and if for any possible to occur case P expressed by wff of $\mathscr{L}$:

$$\forall_P((P \bullet Conditions1) \rightarrow (P \bullet Conditions2))$$

and,

$$\exists_P((P \bullet Conditions2) \not\rightarrow (P \bullet Conditions1))$$

then we recognize that in a view of more restrictive character of a rule r_1 we may conclude that a rule r_1 is more specific than a rule r_2. The key challenge of such a model is an unrealistic assumption in which we have to list all cases which satisfy a rule's conditions. Firstly, it is impossible to predict all possible real-life cases (except some trivial ones); secondly, how can we recognize if a given case can possibly occur?

Since we cannot foresee all possible real-life cases, our model does not allow for recognizing all general-specific relations between rules. The only thing we can do is analyze the antecedants of conflicting rules to discover whether the condition of subsumption is fulfilled. There are some kinds of specific situations which allow us to make inferences, for example:

- Restricting Rule
  $restrictingRule$:
  $(r_1 : Conditions1 \twoheadrightarrow Conclusion1) \wedge$
  $(r_2 : (Conditions1) \wedge (Conditions1a) \twoheadrightarrow Conclusions) \wedge$
  $(Conditions1 \neq Conditions1a) \Rightarrow$
  $r_2 >_{spec} r_1$
  If every case which satisfies the conditions of a legal rule r_2 also satisfies the conditions of r_1, then rule r_2 is more specific than r_1.
- Subsuming Rule:
  $subsumingRule$:
  $(r_1 : Conditions1 \twoheadrightarrow Conclusion1) \wedge$
  $(r_2 : (Conditions1) \vee (Conditions1a) \twoheadrightarrow Conclusion2) \wedge$
  $(Conditions1 \neq Conditions1a) \Rightarrow$
  $r_1 >_{spec} r_2$
  A legal rule r_1 is more specific than a rule r_2, because every case which satisfies conditions of r_1 also satisfies conditions of r_2.

Both restricting and subsuming inference rules are a part of $\mathscr{R}_d$ ($restrictingRule \in \mathscr{R}_d$, $subsumingRule \in \mathscr{R}_d$).

Looking at the problem of *lex specialis...* in a more general way one can notice that the above mechanism does not allow for the recognition of all general-specific relations between legal rules. However, it is also worth to emphasize that in real legal practice it is also not easy to recognize them without any doubts.

Having the order $>_{spec}$ representing the specificity-generality relation between legal rules, we can model *lex specialis...*: If we recognize r_n and r_m as conflicting rules, then we may solve the above conflict on the basis of the *lex specialis...* principle ($lexSpecialis \in \mathscr{R}_d$):
$lexSpecialis : (r_n >_{spec} r_m) \wedge (r_n \in Prem(A)) \wedge (r_m \in Prem(B)) \Rightarrow A \succeq B$

If A, B are arguments built on conflicting legal rules, both arguments attack one another (rebut or undercut), and it is possible to conclude (on the basis of $lexSpecialis$) an order $A \succeq B$, then argument A defeats argument B.

The *lex specialis...* principle is slightly different from the previous ones. The most important difference lies in the commonsense background of the method: both *lex superior...* and *lex posterior...* are based on purely legal knowledge taken from statutes, while *lex specialis...* is (similarly to argument from social importance [5]) based on commonsense knowledge.

V. Ordering of inference rules

Legal practice and theory have developed a collection of methods of legal rules' conflict resolution, but it is important to notice that their results do not have to be compatible in the sense that one of the methods can give preference to one rule and second method can give preference to another one. Generally speaking, if there is a conflict between two conflict resolution methods, the theory of law assumes the following order of methods: *lex superior* prevails over *lex specialis...* which prevails over *lex posterior...* which prevails over axiological methods. Unfortunately, it is not so obvious in real-life legal cases: sometimes, in specific cases, such an order does not work and, for example, *lex specialis...* defeats *lex superior...*. Prakken and Sartor's logic ([9], [25]) allows for reasoning about priorities between arguments and rules whose elements may be helpful in such conflict resolution.

However, for the sake of this study we assume that in the case of incompatibility of conflict resolution methods (two methods infer different results), the above order will be applied.

Although our conflict resolution inference rules can be seen as a kind of higher level inference rules, in the argumentation process they are treated in the same way as ordinary inference rules. Moreover, $ASPIC^+$ does not distinguish any particular kinds of arguments except strict and defeasible ones. Hence arguments created on the basis on our inference rules can be attacked and defeated by other arguments whose strength can be regulated by the above order. How can it be applied in our framework? First of all, we have to notice that not all conflict resolution methods work in all cases. If conflicting norms are at the same level in the legal act hierarchy and were released at the same time, the other methods (for example, *lex specialis...*) can be applied. Also, if two methods can be applied and their results are not compatible, the order:
$lexSuperior \succeq lexSpecialis \succeq lexPosterior \succeq$ axiological methods
allows for defeating the conflicting arguments.

VI. Example

Let us illustrate our ideas by a simple example. There are two legal defeasible rules:

$$r_1 : vehicle \twoheadrightarrow \neg allow(enterThePark)$$

$$r_2 : vehicle \wedge emergency \twoheadrightarrow allow(enterThePark)$$

as well as 3 necessary axioms:
$r_3 : ambulance \supset vehicle$
$f1 : ambulance$
$f2 : emergency$

$r_1 \in act_k$, $r_2 \in act_l$ $act_k, act_l \in K_l$
$r_3, f1, f2 \in K_n$

On the basis of the above knowledge, we may build two argument chains A and B:

$A_1 : f1$
$A_2 : A_1, r_5 \rightarrow vehicle$
$A_3 : A_2, r_1 \Rightarrow \neg allow(enterThePark)$
$B_1 : f1$
$B_2 : f2$
$B_3 : B_1, B_2, r_2 \Rightarrow allow(enterThePark)$

In the above example, argument A_3 attacks (rebuts) B_3 and B_3 attacks (rebuts) A_3. Since both arguments have only one defeasible rule (respectively r_1 and r_2), r_1 and r_2 are legal rules and $r_1 \neq r_2$, then we may conclude that r_1 and r_2 are in conflict.
Let us assume that both r_1 and r_2 are taken from acts which are at the same level in the hierarchy and have the same date of release:

$K_n \vdash (H(act_k) \not\succ_{HCH} H(act_l)) \wedge (H(act_l) \not\succ_{HCH} H(act_k))$.
$K_n \vdash (D(act_k) \not\succ_{time} D(act_l)) \wedge (D(act_l) \not\succ_{time} D(act_k))$.

The above knowledge does not allow us to solve the conflict on the basis of *lex superior...* or *lex posterior...*, hence the possibility of using *lex specialis...* will be checked.

We do not have any additional knowledge about the case, but if we compare two conflicting rules:

$r_1 : vehicle \twoheadrightarrow \neg allow(enterThePark)$
$r_2 : vehicle \wedge emergency \twoheadrightarrow allow(enterThePark)$

we can notice that on the basis of the *restrictingRule* inference rule, argument B_4 can be constructed:

$B_4 : r_1, r_2, restrictingRule \Rightarrow r_2 >_{spec} r_1$

and, on the basis of *lexSpecialis*, argument B_6 can be constructed:

$B_5 : B_4, r_2 \in Prem(B), r_1 \in Prem(A) \Rightarrow B \succeq A$

then since we know that B attacks A (rebuttal on A_3), $B \succeq A$ and the only defeasible steps in argument chains are rules based on r_1 and r_2, argument B defeats argument A.

VII. Conclusions and future work

Legal decision support systems as well as argumentation mining systems require an adequate and comprehensive formal model of various aspects of the argumentation process. AI and law researchers agree that legal reasoning cannot be seen as a simple, mechanical, deduction-based inference, like it was treated in classical expert systems. The key point lies in the issue of argumentation: Most legal decisions are, in fact, results of a trade-off between various arguments built on the basis of legal knowledge, commonsense knowledge, legal and non-legal inference rules. This is why formal modeling of argumentation is one of the crucial elements of legal advisory systems as well as argumentation mining systems (which are

probably the future of legal informatics and a tool which can help to search, analyze, and construct new arguments).

The problem of modeling of conflicting arguments has been widely discussed in the AI and law literature. A number of authors have presented their own models of the mechanisms of conflict resolution. However, most of the existing models do not distinguish between arguments based on legal statutes and ordinary commonsense reasoning, which, in my opinion, is an oversimplification. In legal reasoning, the issue of legal rules' conflict solving is very precisely regulated and cannot be treated the same way as it is in ordinary commonsense arguments.

The main aim of this work is to formalize the mechanism of resolving conflicts between statutory legal rules with a view to implementing it into the legal advisory system. The additional aim is to incorporate the model into *ASPIC*$^+$, one of the most comprehensive argumentation modeling frameworks, thanks to which the model can be used to represent a wide range of complex real-life legal cases including various kinds of arguments. The model was created on the basis of Polish law, however, it can be easily adapted into most statutory legal systems.

In summing up the above, the most important contributions of this paper are as follows:

- a discussion of the nature of conflict between legal rules,
- a comprehensive formal model of such a conflict,
- the distinction between legal and commonsense rules,
- a formal model of three main methods of conflict solving,
- the incorporation of the model into the APSIC+ argumentation framework.

There are two important issues calling for further discussion which I am going to elaborate in my future work. The first one is the problem of modeling the strength of an argument and the balance between two conflicting commonsense arguments. Real-life arguments are very often evaluated in the light of their strength, rightfulness, adequacy, etc., which are challenging to estimate and compare. However, this is the basis on which commonsense arguments defeat one another and it is difficult to imagine a system modeling real-life argumentation without a possibility of reasoning about its strength, rightfulness, adequacy, etc. The model of the strength of an argument will be tested by the MIZAR proof checker [28]. The second (parallel) direction of future work is implementation of the above model into a small decision support system similar to the ones presented in [29] or [30].

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