Modelling Reasoning with Precedents in a Formal Dialogue Game

Henry Prakken *
Department of Mathematics and Computer Science, Free University Amsterdam, The Netherlands. henry@cs.vu.nl, http://www.cs.vu.nl/henry

Giovanni Sartor
Faculty of Law, The Queen's University of Belfast, Belfast BT7 1NN, Northern Ireland. sartor@cirfid.unibo.it, http://www.qub.ac.uk/gs/sartor1.htm

June 19, 1998

Abstract. This paper analyses legal reasoning with precedents in the setting of a formally defined dialogue game. After giving a legal-theoretical account of judicial reasoning with precedents, a formal method is proposed for representing precedents and it is discussed how such representations can be used in a formally defined dialectical protocol for dispute. The basic ideas are to represent cases as argument structures (including pro and con arguments, and the arguments for adjudicating their conflicts) and to define certain case-based reasoning moves as strategies for introducing information into a dispute. In particular, analogizing and distinguishing are conceived as elementary theory construction moves, which produce new information on the basis of an existing stock of cases. The approach also offers the possibility of using portions of precedents and of expressing criteria for determining the outcome of precedent-based disputes.

The analysis, which is partly based on argument-based semantics of defeasible reasoning, has two aims. The first is to provide a formalization of certain aspects of legal theories on judicial reasoning and judge-made law, and the second is to provide formal foundations for certain aspects of computer programs for case-based reasoning in the legal domain.

Key words: Defeasible argumentation, case-based reasoning, precedents, normative dialectics

1. Introduction

General Setting

Research on case-based reasoning (CBR) is one on the main streams of AI & law (e.g. McCarty & Sridharan, 1981; Rissland & Ashley, 1987; Ashley, 1990; Berman & Hafner, 1991; Skalak & Rissland, 1992; Branting, 1994 and Aleven & Ashley, 1996). This research has provided not

* Much of the research reported in this article was done while the first author was employed at the Computer/Law Institute of the Faculty of Law, Free University Amsterdam, supported by a research fellowship of the Royal Netherlands Academy of Arts and Sciences, and partly by Esprit WG 8319 'ModelAge'. The final version was written while the first author was employed at the Institute of Applied Information Technology of the GMD Bonn, Germany, supported by VIM (A VIrtual Multicomputer), a project funded by the EC's Human Capital and Mobility programme.

only computer applications, but also models and insights relevant for the theoretical understanding of judge-made law, which parallel the investigations of legal theory (e.g. MacCormick, 1978; Goldstein, 1987; Raz, 1989 and Cross & Harris, 1991). In particular, it has focused on the dialectical process of citing and comparing cases, and on the various heuristics of case-based reasoning.

Another development in AI & Law is logical research on nonmonotonic, or defeasible legal reasoning (e.g. Sartor, 1992; Prakken, 1993; Gordon, 1995; Prakken & Sartor, 1996b; Verheij, 1996 and Hage, 1996, 1997). Here the main concern is to give logical accounts of legal reasoning with incomplete, uncertain or inconsistent knowledge. This development draws on and adds to the tools of nonmonotonic logic.

A particularly useful tool has been found in logical systems for defeasible argumentation, which model nonmonotonic reasoning as the construction and comparison of (logical) arguments for and against a certain proposition (e.g. Pollock, 1987; Loui, 1987; Dung, 1995; Vreeswijk, 1997). In our opinion, these systems provide a tool for connecting and integrating the two research developments just mentioned since, unlike other nonmonotonic logics, they do justice to the dialectical structure of case-based knowledge and to the adversarial procedure of case-based reasoning. In particular, they make it possible to model case-based reasoning as a special type of defeasible argumentation, which combines a logical system (in the tradition of nonmonotonic logics) and a specific set of argument moves and heuristic strategies (in the tradition of case-based research). The first contributions adopting this approach were of Ron Loui and his colleagues (Loui et al., 1993; Loui & Norman, 1995), and the present paper (which is a revised and extended version of Prakken & Sartor, 1997b) further develops the attempt of modelling case-based reasoning with the help of logical argumentation systems.

Focus of Research

In pursuing our aim, we focus on reasoning with precedents in an adversarial setting. We first give a legal-theoretical account of judicial precedent-based reasoning, resulting in a set of requirements for formal and computational models. Then we present a formal model of dialectical reasoning with precedents that aims to satisfy these requirements, and that is defined on top of a logical system for defeasible argumentation. This system is the one we previously developed in Prakken & Sartor (1996b; 1997a), and which is based on the abstract logical approach to defeasible argumentation of Dung (1995) and Bondarenko et al. (1997). We then use our formal model in an analysis of aspects of computer programs for case-based legal reasoning. It is this analysis

which explores the connection between the two research developments. At the same time, our formal model can be regarded as a formalization of the discussed aspects of legal theories on judicial reasoning, and therefore as a contribution to legal theory.

We shall in particular focus on HYPO style case-based reasoning, i.e., on the dialectical interchange of arguments which support or oppose a claim by citing, analogizing or distinguishing legal precedents (Rissland & Ashley, 1987; Ashley, 1990). Our aim here is twofold. Firstly, we want to model some of HYPO's argument moves within our formal dialogue game for reasoning with conflicting arguments of Prakken & Sartor (1996b; 1997a). And secondly, we want to propose a richer method for representing cases than is allowed by HYPO. We shall also briefly compare our proposal to some other extensions of and alternatives to the HYPO approach, the CABARET system of Skalak & Rissland (1991), the work of Branting (1991; 1994), and the CATO system of Aleven & Ashley (1996; 1997).

Our proposal has the following main ingredients. Both cases and case-based reasoning are seen as pieces of argumentation. Firstly, each past case is represented as a completed or frozen piece of argumentation, i.e., as a dialectical argument structure. Such a piece of argumentation consists of a set of premises grounding (possibly) conflicting arguments, where the winning argument supports the decision of the case. Secondly, case-based reasoning concerning a new situation will in our approach be modelled as a process of argumentation, where each argument move may make direct or analogical use of precedents, or may distinguish precedents used by the opponent. What is also important is that the dialectical interchange of arguments will conform to the rules of the dialogue game defined in (Prakken & Sartor, 1996b) but that, unlike there, the parties will be free to introduce new premises during the dialogue. In fact, one of our main aims is to reconstruct case-based reasoning moves as rational heuristics for introducing new premises into a dispute. In this way we hope to reproduce the basic forms of precedent-based reasoning (following a precedent, analogizing it, distinguishing it from the present case) while embedding such reasoning forms in a more general formal model of defeasible argumentation. It should be stressed that our model, although choosing for a particular type of analogical reasoning, does not crucially depend on this choice; it is compatible with diverse approaches to analogy and theory construction in case-based reasoning.

Nature of our Research

There are two important differences between our model and the other systems that we shall discuss. The first is that while HYPO, CATO,

CABARET and Branting's GREBE system are implemented systems, we present a more abstract, logical model. We think that such abstract models are a useful complement to the development of actual systems and computational models. A logical formalization makes it possible not only to disambiguate and make things precise, but also to prove formal properties, to view clearly similarities and differences between various systems and approaches and to assess the possibility of their integration. Furthermore, it may show how results obtained in other areas (for instance, proof theory), can be made available.

A second difference is that while HYPO, CABARET and CATO have a more 'cognitive' approach, aimed at generating realistic disputes, our approach is more 'normative', defining a rational procedure for testing the tenability of a claim. This requires some explanation. Our aim is to apply the traditional dialectical method as studied by philosophers, which is aimed at testing the tenability of a claim in a dialectical inquiry (see e.g. Rescher (1977) for an application of this method in epistemology, and Loui (1998) for a defence of this method in nonmonotonic reasoning). The adoption of a normative approach has two important consequences.

The first is what we call 'dialectical asymmetry'. The proponent and the opponent of a claim have different tasks: the proponent must prove that the claim is tenable, while the opponent just has to prevent the proponent from doing so; it is not the opponent's task to prove that the opposite claim is tenable. The second consequence of normative dialectics is that it must be possible to determine the relative strength of each move, to see whether it adequately responds to the other party's previous move. In particular, while the proponent's arguments must be stronger than the opponent's previous move, the opponent's arguments only have to be not weaker than the proponent's previous move.

In CBR systems these normative aspects are largely absent: for instance, the intended output of HYPO and CABARET is not an answer to the question whether a claim is tenable; instead, the intended output is a dispute as it could take place between 'good' lawyers. It should be noted, however, that the difference is not clear-cut. We are also interested in defining realistic disputes; our model can be said to define which of those disputes conform to the ideal of normative dialectics. And HYPO and CABARET also have criteria for the strength of arguments: for instance, each cited case must be as similar as possible to the current fact situation. This rule (and others) can be said to prune the space of possible disputes. But HYPO and CABARET have no dialectical asymmetry: the rules are the same for the plaintiff and the defendant. And these systems do not implement a notion of

'winning' a dispute (except in a few cases). Instead, they assume that the final choice is made outside the system.

Background: Four Layers in Legal Argument

We shall carry out our investigation against the background of a four-layered picture of legal argumentation, discussed in (Prakken, 1997) and (Sartor, 1997).[1] The first layer (the *logical* one) provides the logical structure of single arguments, i.e., it defines how pieces of information can be combined in order to provide basic support for a claim. The second layer (the *dialectical* one) focuses on conflicting arguments: it introduces such notions as 'counterargument', 'attack', 'rebuttal' and 'defeat', and it defines how, given a set of premises and evaluation criteria, it can be determined which of the possible arguments prevail. These are the notions defined by the above-mentioned logical systems for defeasible argumentation. And since Dung (1995) has shown that (more or less) any nonmonotonic logic can be reformulated as such a system, one can say that the dialectical layer is the layer that is addressed by nonmonotonic logic.

The third layer (the *procedural* one) regulates how an actual dispute can be conducted, i.e., how parties can introduce or challenge new information and state new arguments. In other words, this level defines the possible speech acts, and the discourse rules for when and how these speech acts can be performed. Thus the procedural layer differs from the first two in one crucial respect. While the logical and dialectical layer assume a fixed set of premises, at the procedural layer the set of premises is constructed dynamically, during a debate. This also holds for the final layer, the *strategic* or *heuristic* one, which provides rational ways of conducting a dispute within the procedural bounds stated at the third level; i.e., it concerns heuristics and strategies for expanding the available knowledge and constructing new theories.

All four layers are to be integrated into a comprehensive view of argumentation: the logical layer defines, by providing a notion of arguments, the objects to be evaluated at the dialectical layer; the dialectical layer offers to the procedural and heuristic layers a judgement of whether a new argument might be relevant in the dispute; the procedural layer constrains the ways in which new inputs, supplied by the heuristic layer can be submitted to the dialectical one; the heuristic layer provides the matter which is to be processed in the system. Each layer can obviously be studied (and implemented) in abstraction from the other ones. For example, the study of the dialectical layer can abstract from the procedural and the heuristic layers, when the pool of given information is fixed; the study of the procedural layer can abstract from the heuristic level when ways for regulating the interac-

tion of human beings are considered; the study of the heuristic layer can just focus on ampliative strategies, regardless of their procedural admissibility and of the dialectical evaluation of their products. However, it would be a grave misconception, and a serious hindrance to the development of a large-scope formal theory of legal reasoning, to regard those layers as alternative rather than as complementary.

In our opinion, much AI & law research can be classified into this four-layered model of argumentation. The logical layer includes logical deduction, and the basic reasoning forms of rule-based expert systems (forward chaining and backward chaining). The dialectical layer was addressed by our previous work, which defines the status of arguments on the basis of a given pool of conflicting premises. The procedural level is the central focus of Gordon's (1995) Pleading Game, which studies argumentation protocols for certain types of legal disputes, and of Hage *et al.* (1994), who give a procedural account of hard cases. The fourth level, finally, has been especially studied in relation to case-based reasoning, as modelled in e.g. HYPO, CATO, CABARET, Branting's work, Loui & Norman (1995), and by McCarty & Sridharan (1981) and McCarty (1995).[2]

The present paper also addresses the fourth layer of argumentation, in the context of case based reasoning. In particular, we regard HYPO-style analogizing and distinguishing as heuristics for adding new information into a dispute, formalizing the view which was earlier defended in (Prakken, 1995). As far as the first and second layer are concerned, we shall build upon our formalization in (Prakken & Sartor, 1996b, 1997a). In the present paper we abstract from the third level, apart from one comment in Section 5.4. on the issue of how a precedent can be said to control a judicial decision.

Outline of the Paper

We start our investigations in Section 2 with a legal-theoretical account of judicial precedent-based reasoning, resulting in a set of requirements for formal and computational models. Then, in Section 3, we briefly discuss some (computational) models of case-based reasoning, especially in regard to those requirements, and we discuss the need for extending these models.

In Section 4 we present the building blocks for our proposal: our previously developed logic for defeasible argumentation, and a new method for representing precedents. Our formal model of precedent-based legal reasoning is then presented in Section 5, after which it is applied to an extended example in Section 6 and compared to the earlier-discussed systems in Section 7.

2. Legal-theoretical Considerations on Precedent-based Judicial Reasoning

In this section we give a legal-theoretical account of judicial precedent-based reasoning. In particular, we analyse the internal structure of a precedent (2.1) and the role of a precedent in further legal decision making (2.2). In this section it is not our aim to be original; instead we want to provide an analysis of some aspects of the doctrine of precedent which can serve as the basis for the formal part of this article and for comparison with other relevant work. Another aim of this overview is to show that many observations in the AI & law literature have their counterpart in legal theory and jurisprudence.

2.1. A Dialectical Account of Judicial Opinions

The expression 'case' is, as it is well known, an ambiguous one, even in legal contexts. It may refer to the whole proceedings of a lawsuit, but more frequently it just refers to the final act of those proceedings, i.e., the decision of the judge supported by his/her opinion. Only in this second meaning can cases usually be found in law reports and can they be said to constitute an authority for future decisions and to be relevant for case-based reasoning.

We claim that in general cases have a dialectical structure, i.e., they contain not only arguments supporting the decision but also arguments attacking it, and arguments why these attacks do not succeed. However, in considering whether cases have a dialectical structure, the two notions of 'case' just sketched must be distinguished. The assertion that legal proceedings normally do (and should) exhibit a clear dialectical structure is just a truism: they exemplify in the most clear and paradigmatic way the dialectical process of disputation. This process starts when the plaintiff and the defendant identify the problem and produce conflicting arguments for its alternative solutions and it terminates when the judge determines the output of the proceedings. The assertion, instead, that judges' opinions are 'dialectical' requires further considerations and qualifications.

We argue that, although being a monological discourse, often a judge's opinion reproduces (and possibly extends) the dialectical context of the disputation between the parties. This is the case when the judge explicitly answers the issues raised in the parties' debate, on the basis of an evaluation of their arguments (and of the further arguments provided by the judge him/herself). Legal justification, at least in hard cases, requires that "so important an aid to the intelligent and living apprehension of a truth, as is afforded by the necessity of explaining

it to, and defending it against, opponents" (Mill, 1974). Therefore, at least when significant legal problems have to be solved, a judge's opinion may present three features, which should be preserved in the formal and computable representation of the precedent (when practically feasible).

Firstly, the opinion may contain not only the argument supporting the adopted decision, but sometimes also the defeated arguments to the contrary. This is since in such cases a justification limited to the winning argument would not express an adequate rationale and would fail to clarify the context and the limits of the winning argument. Secondly, the opinion may contain complex arguments, which require a sequence of steps before reaching the desired conclusion; and each of those steps may involve the necessity of adjudicating the conflicts with arguments to the contrary. Preliminary or prejudicial questions need to be solved in order to tackle the final substantial point (or an argument pleading for the substantial point may be challenged by raising issues concerning preliminary points). A representation that compresses judicial reasoning in the immediate connection between facts of the case and final decision misses a fundamental feature of judges' decision making. And finally, the opinion may include more argument-layers: the conflict between basic arguments needs to be adjudicated by higher level arguments, which may again be in conflict, etc. Without those higher level arguments, which substantiate a rationale for decisions on controversial points, judicial reasoning would in some cases appear impoverished and arbitrary.

In conclusion, we argue that a satisfactory model of precedents should account for the possibility of representing cases as sets of (possibly) conflicting, multi-step and multi-level arguments. Precedents just including consistent, one-step and one-level arguments should be considered as limiting cases of a richer framework. Obviously, this possibility is not intended as a facility to be offered by each computable formalization of case-based reasoning (and each computer application). It is only a requirement for a dialectical theory of precedents, which can be adequately constrained in specific application domains. Let us now examine the three 'internal' features of judicial precedents in more detail.

2.1.1. *Judicial Rationales as Dialectical Multi-argument Structures*
The traditional view of the justification of legal decisions is the deductive one: to justify a decision means to produce a consistent set of legally valid and/or factually true premises which logically imply the decision of the case. Different variants of the deductive model can be found, according to the nature of the premises and legal sources from

which those premises have to be obtained. The main alternative lies in the distinction between legalistic approaches (according to which those premises are to be found in law texts) and conceptualist approaches (according to which those premises are to be found in jurists' definitions). Nevertheless, the deductive approach is also compatible with other ways of obtaining the premises (from precedents, from a natural law code, from social customs, etc.). Some authors have therefore affirmed that the need of a deductive justification for judicial decision making is independent from the nature of the premises of such a deduction. In their opinion, the advantage of a deductive justification consists in making those premises explicit, and so in facilitating control and critique (Klug, 1966). Nowadays this neutral version of deductivism seems to be accepted by most legal theorists, who frequently stress the necessity that every legal decision is given a deductive justification, frequently also called the internal justification (cf. MacCormick, 1978; Wroblewski, 1983 and Alexy, 1989, pp. 221–230).

However, we argue that this 'neutral' version of deductivism is also inadequate, because of the disputational nature of legal reasoning and particularly of judicial reasoning. To justify a judicial decision it is not always sufficient to produce a single argument; sometimes it is necessary to establish that the winning argument prevails over all arguments to the contrary, at least when those arguments were presented by the losing party. Defeated arguments are also fundamental for qualifying the strength of the victorious thesis in future cases.

Let us consider, for example, the *Donoghue v. Stevenson* case ([1932] AC 562), a bench-mark case of English tort law, in which a manufacturer was held responsible for marketing a bottled ginger ale containing a snail, on the basis of the rule that marketing a defective product determines the liability of the manufacturer (we simplify the original rule for clarifying the example). In their opinion, the judges disposed of certain counterarguments, such as the counterargument that no remedy should be available if no contractual relation exists between the manufacturer and the consumer. Such counterarguments cannot therefore be successfully produced in future cases (unless the authority of the precedent is questioned). However, this does not hold for those counterarguments which are not adduced in the precedent, and especially for those that were not grounded in the facts of the precedent (for instance, the arguments that no remedy should be available because of a disclaimer by the manufacturer, or because of the knowledge of the defect by the consumer). Those counterarguments can be accepted in new cases as distinctions that restrict the ratio of the precedent, without questioning its authority, as we shall see in the following.

In this perspective, judicial reasoning seems to consist of an exercise in "unilateral dialectic", intended as a disputational model of inquiry in which "one develops a thesis against its rivals, with the aim of refining its formulation, uncovering its basis of rational support, and assessing its relative weight" (Rescher, 1977, p. 47). Such a dialectical exercise is sometimes required not only for solving the case, but also for building a rationale for its decision, intended as "an architectonically organised structure of contentions and grounds" (Rescher, 1977, p. 53). Such a rationale should contain plausible pro and con arguments on relevant issues, and the evaluation of their respective strength.

A dialectical style in judges' opinions is specifically promoted by the dialogical function of a judge's rationale: the judge must reply to the arguments of the parties, and particularly to those coming from the losing one. The degree in which opinions are in fact dialectical varies in different legal cultures. In particular, appellate decisions in common law usually exhibit a more elaborate argumentative mode. Nevertheless, civil law judges are sometimes also explicitly urged to argumentatively justify their choices. For example, Taruffo (1975, p. 266) qualifies as fictitious those justifications that "whenever a statement represents an hypothesis chosen by the judge within a range of alternatives" present this statement as the only possible solution to an issue, without justifying its choice. In this perspective, those opinions making no mention of plausible contrary arguments are to be qualified as legally defective, lacking a sufficient justification.

2.1.2. *Judicial Arguments as Multi-step Structures*

Judicial reasoning frequently proceeds in a stepwise manner. Generally, judicial arguments consist of a sequence of linked inference steps. In each step certain conditions support a certain conclusion, according to a certain general inference rule. In a stepwise argument, intermediate conclusions become the preconditions of further inferences until the final conclusion is reached. For example, in cases concerning tort responsibility, preliminary rulings may be stated on questions such as the negligence of the defendant or the existence of a causality relationship between her/his behaviour and the damage. Moreover, in cases concerning the vicarious liability of the employer for the harm caused by the tort of the employee, a ruling may be necessary as to the existence of an employment relation.

We argue that such a stepwise structure should be reflected in the representation of the precedent, which should reproduce the dialectics of preliminary decisions, without compressing all reasoning into just one step. Such a compression in fact means a loss of information and limits the possibility of extracting rules relevant for other cases (likewise

Branting, 1994). So, for example, the ruling on the notion of employment established in cases concerning employer's liability is *prima facie* relevant for subsequent cases concerning social security duties of the employer. Obviously, such an application of a rule outside its original argumentative context is highly defeasible: in some cases the functional relation of a preliminary ruling to the final decision may exclude its application to a different type of case (for example, different areas of law or different factual contexts may require different notions of negligence). Nevertheless, in the absence of information to the contrary, all rules in the stepwise argument leading to the solution of the case are to be considered autonomous case-law rules, transferable to new cases.

This view subsumes those legal theories which stress the possibility of having multiple rationes in a case, when the judge, in order to justify its decision has to settle multiple different points of law, or when he/she provides alternative justifications (MacCormick, 1987).

2.1.3. *Judicial Rationales as Multi-level Structures*

Finally, we consider whether the solution of a conflict between two arguments is always an unreasoned decision pertaining to the free evaluation (the sovereign prerogative of choice) of the judge, or whether it may need a justification by means of higher-level arguments. In this respect we agree that, sooner or later, reasoning must stop, having reached a point such that (according to the judge's view) no further plausible reasons can be found to question a plausible argument. This stopping, however, does not need to happen immediately after noticing that conflicting rulings apply to the case. In many cases the judge may consider (and one party may present) a rationale for his/her choice for one of the conflicting arguments.

This aspect is usually tackled by legal theorists under the label of second-order or external justification (cf. MacCormick, 1978, pp. 101 ff. and Alexy, 1989, pp. 230 ff.). In our perspective, such second-order justification involves two different aspects: producing arguments which substantiate or back a questioned premise (i.e., which conclude that the premise is applicable); and producing arguments which adjudicate conflicts between other arguments.

Here we focus on the second aspect (for analyses of arguments of the first type see e.g. Hage, 1996, 1997). If the judge has the duty of producing a convincing rationale, then whenever presented with a really controvertible conflict of arguments he/she should provide not only a preference, but also convincing reasons for this preference. Those preference reasons are also important for determining the strength of the winning argument and the possibility of successfully extending it to new cases: if the conditions which allow to adjudicate the conflict in

favour of a certain argument do not hold in the new case, then the adjudication of that conflict can rightly be questioned. On the other hand, preference reasons having a general character should also be extensible to new cases, in order to adjudicate those argument conflicts which are subsumable under them. This seems to correspond to a widespread judicial practice, which uses preference reasons in new cases, although those cases do not directly concern the solution of the same substantial issue. Consider for example the *Simmenthal* case, a famous decision of the European court of Justice (1978 ECR 777) where EC law was said to prevail over national laws of the member states, in order to solve a specific conflict between a national law rule and an European one. The *Simmenthal* ruling was later used in a number of cases in order to support the preference of other European rules against other national ones.

2.2. The Binding Content and the Dynamics of Case-based Law

So far we have focused on the content of an individual decision. Let us now look at the dynamic features of judicial precedent-based reasoning, i.e., how does a precedent affect decisions in new cases? Different views exist on the theoretical definition of the ways in which precedents affect future decision-making. In this debate at least three orders of problems are addressed:

1. Providing the structure of the basic dialectical argument moves (when can a precedent be directly followed, how can it be analogized to a new situation, how can analogy be countered by distinguishing?).

2. Identifying and deciding the conflicts of precedents (when does a precedent govern the case, and what should be done with conflicting precedents?);

3. Understanding the dynamics of case law (how can a precedent have a fixed content, if its relevance is to be continuously reassessed in the framework of the subsequent decisions?).

2.2.1. *Argument Moves in Reasoning with Precedents*

Let us first consider the basic ways of using precedents in solving new cases. Clearly, if precedents have a dialectical structure, then the solution of new cases also proceeds dialectically. Therefore the use of precedents for solving a new case should be modelled as a dialectical process.

In such a process at least the following three types of moves should be possible, in regard to a precedent: following a precedent, analogizing it, and distinguishing it.

Before considering these moves, let us remark that according to the features described above, precedents may have an elaborate argumentative architecture: they include multi-step arguments where certain facts support, according to a certain rule,[3] a certain legal qualification, which in turn, according to another rule, may support a further legal qualification, and those arguments may be opposed and compared. It is not the whole precedent that is mentioned in those moves, but just the relevant portions of it, i.e., the rules which may be useful for supporting the party's contention. Let us also remark that a precedent can be cited not only in order to obtain the same decision in the current case, but also to support an outcome opposite to the one that the precedent actually had (a possibility that was suggested by Berman & Hafner, 1991, p. 17). This happens when in the precedent the judges stated a rule although this was successfully countered by an exception: such a rule can take the lead in subsequent cases where the exception does not hold. In common law systems this is the standard way of citing the famous case of *Hedley Byrne & Co Ltd v Heller & Partners* (1963) in which the British House of Lords stated that as a general rule all professionals are responsible for their negligent statements even if the damage does not concern the client, but then acquitted a professional who expressed a negligent statement since he had made a disclaimer. This precedent is usually cited in order to support the responsibility of a professional when no such disclaimer is made, that is, for the opposite outcome.

For these reasons our notion of case rules stretches beyond the usual definition of a ratio decidendi in that it also includes those rulings contained in losing arguments. In fact, if the judge felt the need to consider those rulings, this means that they have a certain strength, so that they might take the lead in other cases, in which prevailing reasons to the contrary do not apply. An important point is that the possibility of citing each rule in a precedent requires ways of establishing the rule's strength which go beyond the dichotomy of ratio decidendi and obiter dicta. In this regard, we agree with MacCormick (1987) that each precedent ruling is only binding "relatively to the cases and the arguments put by given parties". Accordingly, we shall provide a general flexible mechanism for establishing the strength of any ruling contained in a precedent, according to its argumentative function.

Following a Precedent
The first argument move, following a precedent, applies when the mentioned precedents directly governs the new case. From our perspective, following a precedent just consists in selecting a rule from the available precedents and directly using it in an argument concerning the new case. For instance, recall the *Donoghue v. Stevenson* case, where a manufacturer was held responsible for marketing a bottled ginger ale containing a snail, and assume that a new case comes up, where an adulterated bottle of wine is marketed: then the *Donoghue* rule that marketing a defective product determines the liability of the manufacturer can directly support the liability of the wine manufacturer in the new case.

Analogizing a Precedent
The second argument move, analogizing a precedent, consists in using the precedent in order to support the same decision a new case, although the new case is not directly governed by the precedent. From our perspective, this basically consists in producing a new rule (the analogy) which covers the new case, by modifying a precedent rule which cannot be directly applied to the new case. In the present paper we consider the simplest of such modifications, which consists in broadening a rule from the precedent, i.e., in cancelling one or more of the conjunctive conditions (factors) required by that rule (since those conditions are not satisfied in the current case).

However, many other ways of producing analogies exist, for instance, those based on abstraction, where a factor, instead of being cancelled, is replaced by a more abstract concept, in such a way that both the replaced factor from the precedent and a new factor in the current case are an instance of this abstract concept. In Dutch civil law, a classic example of this type of analogy[4] concerns the analogical application of a statutory rule, viz. Section 1612 of the Dutch Civil Code. This rule says that selling living accommodation does not affect an existing lease. This rule was analogically applied to a case where a house was not sold but donated, by arguing that Section 1612 is based on the principle that no transfer of property affects an existing lease, and by then observing that both selling and donating are instances of transfer of property. Thus the rule was first broadened by replacing 'selling' with the more abstract concept 'transfer of property', after which the rule resulting from the broadening (the 'broadening rule') was directly applied to the new case.

Distinguishing a Precedent

The third argument move which we consider is distinguishing, which consists in arguing that the new case is different from the precedent, and must therefore be differently decided, without implying that the precedent was wrong. This may happen in quite different ways. Legal doctrine (e.g. Williams, 1982) differentiates non-restrictive and restrictive distinguishing: the first takes place when the rejected precedent's rule does not directly cover the new case, the second when it does but the new case has a new element, not present in the precedent.

Non-restrictive distinguishing takes place when an analogy is contested. In our reductive view on analogies as broadenings, this form of distinguishing consists in arguing that some of the conditions which were cancelled (in producing the broadening) from the original rule are essential for supporting the conclusion of that rule, and that therefore, unless that condition holds, that conclusion cannot be derived. Such an attack may fail if further reasons are proposed showing that the consequent of the precedent should hold even in the absence of the missing element. For example, the analogy drawn in *Haseldine vs. Daw* ([1941] 2KB 343) was distinguished by pointing to the fact that repairers are not manufacturers, as required by the original *Donoghue* rule. However, the judges rejected the distinction, accepting that the basic reasons supporting the liability of the producer would also support the responsibility of providers of services, such as repairers.

Let us now move to *restrictive distinguishing*. Here the original rule directly covers the new case, but it is argued that the new case has an additional feature which impedes us from drawing the conclusion established by that rule. In other words, restrictive distinguishing consists, from our point of view, in attacking a precedent-based argument by means of a convenient counterargument (based on the features of the new case). As an (unsuccessful) example, consider the case *Grant v. The Australian Knitting Mill* ([1936] AC 85), where a customer had contracted dermatitis from wearing pants containing an excess of sulphites, and cited *Donoghue*. The defendant tried to distinguish by affirming that the pants where in a paper envelope, supposed to be open, so that there was the theoretical possibility of discovering the defect before the sale. The judges however, refused to accept the relevance of this aspect since in both cases the article was supposed to reach the consumer or user subject to the same defect as it had when it left the manufacturer. A successful counterexample was put forward in the case *Fair v. Butters* ([1932] AC 562) where a workman died because of a defective crane, and compensation was asked citing *Donoghue*. Here the defendant was successful in distinguishing, since the fact that the workman knew the

defect (since he had put the crane together) was considered sufficient to exclude liability of the manufacturer.

Overruling a Precedent
Distinguishing in a proper sense is impossible when the factor which (arguably) pushes the decision in the opposite direction was already included in the precedent. In such a context, we can no more say that the precedent's decision was right, although the new case can be distinguished from it. The precedent already compared the argument leading to the precedent's decision and the contrary argument based on the factor we are pointing to, giving precedence to the first one. If we do not accept this evaluation we must say that the precedent was wrong, so that an adequate solution in the new case requires overruling it. From our point of view, overruling consist in defeating precedent-based arguments on the basis of a counterargument based on substantive considerations.

2.2.2. *Conflicting Precedents*
It frequently happens that different precedents are analogous to a new problem situation and that those precedents point to opposed outcomes, so that a choice must be made. One criterion for making the choice is which precedent is more similar to the new case. In AI & Law this criterion has been extensively studied (cf. HYPO's 'more-on point' relation). However, we like to stress that besides similarity lawyers may also use other criteria. As Summers (1997, p. 53) affirms, when faced with a conflict of precedents, "courts have a variety of methods" by which to solve conflicts of precedents: first "the court should determine whether one precedents comes from a court higher in the judicial hierarchy", alternatively, it could "take note of which of the precedents in conflict is more recent" or "choose the precedent that seems best justified in substantive policy" or "that seems to do justice in the case under consideration". Note that the hierarchical and the recency criterion are also reflected by the well-known common law doctrine of (implied) overruling, when the subsequent Court has such a power; cf. for English law, *R. v. Porter* [1949] 2KB 128 at 132, cited by Cross & Harris (1991, pp. 132 ff.). See for temporal considerations in comparing precedents also Berman & Hafner (1995). In conclusion, ideally formal and computational models of case-based reasoning should allow for any possible criterion for choosing between conflicting precedents.

Nevertheless, similarity is certainly one of the most important criteria. In this respect, the multi-step nature of judicial opinions introduces a complication not treated by the HYPO model. If a precedent contains multiple issues, it is not the similarity of the entire precedent

to the new situation that must be determined, but similarity of the portion of the precedent that pertains to the issue at hand (likewise Branting, 1991, 1994).

2.2.3. *A Dialectical Perspective on the Evolution of Case Law*
In the debate on precedent, formalistic (strict) and anti-formalistic (sceptic) approaches are frequently opposed (cf. e.g. MacCormick, 1987, p. 157; Twining & Miers, 1991, p. 311). The first approach construes the binding meaning of the precedent on the basis of the text of the opinion and the plausible intention of the judge. The latter approach looks beyond the text and its author, by considering interpretations given by subsequent judges, and more generally, by providing a holistic interpretation of the development of case law.

Our argumentation-based approach allows us to find a middle way between these two perspectives. Each rule, being dialectically supplemented or limited by rules contained in other cases, gains a certain degree of flexibility, without being attributed an indeterminate content. We argue that frequently when the phrase 'the rule of a case' is used, it does not stand only for the original rule deciding (an issue of) that case but rather for a rule set including not only the original rule, but also the analogies drawn for it, and the exceptions defeating it, in subsequent cases. In this perspective, we can understand how subsequent decisions can modify the scope of a precedent's ruling, although leaving the formulation of the original rule unchanged. In particular, this corresponds to our understanding of the process of restrictive distinguishing. As we have seen above, we do not need to model this process by replacing the precedent's rule with a new, more restricted rule, the antecedent of which also includes the complement of the factor justifying an opposite outcome in the new case (Raz, 1989). This is since an equivalent result is given in our framework by the dialectical interaction of the old rule and its new exception.

So, when *Donoghue* was analogized into a rule establishing the responsibility of repairers (or when the analogy concerning legal professionals was rejected) the set of the rules directly or indirectly concerning *Donoghue* was extended. This allowed (or blocked) new inferences in subsequent cases (the extended rule set supports the responsibility of repairers and the non-responsibility of lawyers). This set (or a subset of it) is dynamically constructed by subsequent citations, when the new case satisfies the conditions of more than one *Donoghue*-related rule.

In this way our model is consistent with 'formalist' approaches such as (MacCormick, 1987, p. 170) or (Cross & Harris, 1991, p. 72) who point to those rules or rulings being "expressly or impliedly given by a judge". At the same time our model is also consistent with those

theories where the 'meaning' of a case changes in time, being "the rule of law for which a case is made to stand or is cited as authority by a subsequent interpreter" (Twining & Miers, 1991, p. 312) or Dworkin's view of opinions as chapters of a chain novel, to be continuously reinterpreted (Dworkin, 1985, pp. 158 ff.).

2.3. Summary

In sum, it appears that a complete formal or computational account of precedent-based judicial reasoning should at least satisfy the following criteria. With respect to individual precedents, such a model should be able to represent their dialectical structure, where the judge considers arguments for and against the decision of an issue. The model should also be able to represent the stepwise nature of precedents, where the final decision is reached after resolving a series of intermediate issues. Finally, the model should be able to represent multi-level arguments, including arguments on the choice between conflicting arguments.

With respect to the use of precedents in solving a new case, the model should, firstly, be able to capture the analogical use of precedents in a dialectical setting: similar precedents can be cited, but those citations can be countered on the grounds that the similarity is not sufficient, or that more similar or otherwise preferable precedents point to the opposite outcome. Moreover, the model should be able to determine the similarity of portions of precedents pertaining to one issue rather than of precedents as a whole. Finally, it should leave room for other standards besides similarity for choosing between conflicting precedents.

If these criteria are satisfied and the dialectical nature of cases and case-based reasoning is captured, a middle way becomes possible between the formalistic and anti-formalistic views on the ratio decidendi of a case, where the 'meaning' of a case changes in time, determined by the analogies drawn to a case, and the exceptions made to it.

3. Some Approaches to Case-based Reasoning in AI & Law

As already indicated in the introduction, one of the aims of this article is to build a bridge between AI & Law research on case-based reasoning and more recent logic-oriented research on defeasible argumentation. In particular, we shall consider HYPO-style case-based reasoning, where a case is represented as a set of factors pushing the case towards (pro) or against (con) a certain decision, plus a decision which resolves the conflict between the competing factors; new cases are expected to be

resolved in accordance with decisions performed in the past. Our choice for the HYPO approach is motivated both by its prominent place in AI & law research on case-based reasoning and by its inclination toward dialectical argumentation (it produces an alternating sequence of arguments of a proponent and an opponent of a claim, where each argument attacks the previous argument of the other party). We then discuss some systems which extend or modify HYPO's model, such as Branting's model of ratio decidendi, CABARET and CATO. However, in order not to drown the reader in too many details, we shall mainly focus on HYPO-style analogizing and distinguishing. Nevertheless, it will turn out that some other features of the above-mentioned systems can also be captured by our model.

3.1. Representing and Reasoning with Cases in HYPO

HYPO aims to model how lawyers make use of past decisions in disputes with their opponents. The system generates disputes between a proponent ('plaintiff') and an opponent ('defendant') of a legal claim, where each move conforms to certain rules for analogizing and distinguishing precedents. These rules determine for each side which are the best cases to cite initially, or in response to the opponent's move, and how the opponent's cases can be distinguished. A best case for a side is a case that:

- has the disposition (decision) wished by that side;
- shares with the Current Fact Situation (CFS) at least one factor which supports that disposition;
- shares a most inclusive set of factors with the CFS, in comparison with other cases confirming the desired decision (on pointness).

A citation can be countered by a counterexample, that is, a case that is at least as much on point, but has the opposite outcome. A citation may also be countered by distinguishing, that is, by indicating a factor in the CFS which is absent in the cited precedent and which supports the opposite outcome, or a factor in the precedent which is missing in the CFS, and which supports the outcome of the precedent.

In choosing an appropriate argument move, a crucial aspect is the tendency of facts towards or against a decision. Consider the following example, where the issue is whether a stay in another country changes one's fiscal domicile with respect to income tax. Assume that the following factors pro and con can be identified.

- Pro change is that the old house was given up, while con change is that it was kept.
- Pro change is that the tax payer's company is based in the new country, while con change is that the company is based in the old country.
- Pro change is that the duration of the stay is long, while con change is that the duration is short.[5]

Now assume we have the following three precedents, where the factors that are pro the decision 'change' are given in `typewriter` and the factors con the decision 'change' in *italics* (note that we do not assume that each factor receives a definite value in each case: the duration may be neither long nor short, so that it does not push the decision in any direction).

Prec A:	Factors:	`long duration`, `gave up house`, *domestic company*
	Decision:	change
Prec B:	Factors:	`foreign company`, *kept house*
	Decision:	change
Prec C:	Factors:	`gave up house`, *short duration*, *domestic company*
	Decision:	no change

Assume that the facts of a new case (the CFS) are:

CFS: `long duration`, *domestic company*, *kept house*

All precedents share some factors with the new case:

Prec A $\cap$ CFS = { `long duration`, *domestic company* }
Prec B $\cap$ CFS = { *kept house* }
Prec C $\cap$ CFS = { *domestic company* }

Suppose that Side 1 in the new case wants to argue that in the CFS the fiscal domicile has changed. Although both Prec A and Prec B have this outcome, B is not citable for Side 1, since the only factor it shares

with the common situation is against change; only A can be cited by Side 1. Side 2 can only answer to the citation of A by distinguishing, that is, by referring to the factor *kept house*, which is a con-change factor in the current situation not shared by Prec A, or by referring to `gave up house`, which is a pro-change factor in the precedent not shared by the CFS.

In evaluating the relative force of the moves, HYPO uses the set inclusion ordering on the factors that the precedents share with the CFS. For instance, if in the above CFS a party cites Prec C in defence of the claim 'no change', then the other party can distinguish C with respect to the factor '`long duration`', by drawing an analogy with the 'trumping counterexample' Prec A. The citation of A is regarded as better ('more on point') than that of C, since the factors that A shares with the CFS include those that C shares with the CFS.

Note that HYPO's reasoning forms (citing cases, citing counterexamples, distinguishing) are based not only on the set inclusion ordering on the shared factors with the CFS, but also on the tendency of the factors toward a certain outcome. A case is only citable for a side if this case shares with the CFS a factor favouring that side, and a case missing a factor which is included in the CFS can only be distinguished if the missing factor is against the outcome of the distinguished case. Therefore, in representing precedents it is essential that this tendency of factors be somehow represented. HYPO does so by simply marking them Pro or Con the decision. In this paper we shall propose an alternative method.

In conclusion, HYPO's model is quite attractive, since it emphasizes the dialectical nature of legal reasoning while reducing it to a limited set of argument moves, based on a simple knowledge representation scheme. HYPO also addresses the requirement that judicial rationales must have a dialectical multi-argument structure: this combination of conflicting arguments is implicit in the representation of a case as a set of conflicting factors. Furthermore, HYPO implements ways of analogizing and distinguishing and, finally, HYPO provides a way of comparing conflicting precedents, by using the more-on-point ordering. Those are the aspects of HYPO which we basically want to transfer to our model.

In some regards, however, we also want to extend and generalize HYPO's model. In particular, it has frequently been observed that HYPO has no way of representing how facts contribute to a decision. Cases are essentially represented as a collection of factors, and a decision; no intermediate reasoning steps from factors to decision can be represented.[6] Therefore HYPO does not do full justice to the typical stepwise construction of legal arguments, discussed above in Sec-

tion 2.1.2. In capturing this feature of precedent-based reasoning, we shall adapt a proposal of Branting (1994).

3.2. Branting's Model of Ratio Decidendi

Branting (1991; 1994) has proposed to represent the ratio decidendi of precedents as a 'reduction graph', where more basic factors are linked by 'warrants' to more abstract factors. From our logical point of view this boils down to representing a case as a logical argument, i.e., as a logically valid sequence of reasoning steps starting from a set of premises. In our example Branting would allow a precedent to include a multi-step argument (concluding for the decision of the case), in which the fact that the company has foreign headquarters (in the country where the employee is going to work) determines that it is a foreign company, which in turn determines that the employee's fiscal residence is changed. Such an argument is represented as a combination of rules. The top rule, or 'warrant', concludes to the decision of the case (*foreign-company* $\wedge$ *kept-house* $\Rightarrow$ *change*). The lower level ones are called reduction warrants: they reduce their consequent to the more basic (more factual) conditions contained in their antecedent. For example, *foreign headquarters* $\Rightarrow$ *foreign-company* reduces *foreign-company* to *foreign-headquarters*. Both the final warrant and the reduction warrants are citable, according to Branting, and, more generally, he admits the citation of parts ("portions") of the ratio decidendi (as allowed in his GREBE system, Branting, 1991).

We want to borrow Branting's stepwise representation of precedents and his idea to admit the citation of portion of precedents, and include them in our dialectical model of HYPO-style reasoning. We do not address some other aspects of Branting's model, since they are not directly relevant for our present purposes.

3.3. CABARET

The CABARET system of Skalak & Rissland (1991) has a different focus than our model: it contains heuristics for combining statutory (or other) rules and precedents in statutory interpretation, in particular for using precedents to confirm or contest the application of a rule. An elaborate model of legal reasoning is correspondingly provided. This model is further developed in (Skalak & Rissland, 1992), where argument strategies, moves and primitives are distinguished, and in which the reasoner's point of view is, as in HYPO, essential. Although this work is very interesting, it does not strictly adhere to a dialectical model of dispute of the kind we want to study, and therefore we shall not

go into a full description of CABARET, but just comment on those features which directly address our concerns.

Firstly, CABARET allows statutory rules to be analogized by broadening, in particular by citing a case where some of the rule's preconditions were missing but its conclusion was still upheld. And CABARET allows such analogies to be countered by (non-restrictive) distinguishing. Furthermore, it allows for rules to be contested (discredited), by citing a case where the opposite was decided (this corresponds to what we called restrictive distinguishing). Finally, it allows cases to be used for establishing the antecedent of a rule. Thus CABARET has a certain multi-step structure, since a rule might have more than one antecedent. However, each precedent is still represented as in HYPO, i.e., as a one-step decision.

Within our model we want to capture the just-mentioned reasoning forms. We leave it to future research how other argument forms identified by Rissland & Skalak can be modelled in our framework.

3.4. CATO

The CATO system of Aleven & Ashley (1996; 1997) is an intelligent learning environment for teaching case-based argumentation skills to law students. Like HYPO, CATO uses factors to represent cases. Its set of basic argument moves includes a number of HYPO's argument moves and contains additional ones as well. Unlike HYPO, CATO is capable of organizing multi-case arguments by issues, following a standard rhetorical format. A key element in CATO's architecture is a so-called 'factor hierarchy'.

It is outside the scope of this paper to give a full account of the many interesting aspects of CATO. Here we confine ourselves to the fact that it goes beyond HYPO in addressing the stepwise construction of legal arguments. This is one of several purposes for which CATO employs the factor hierarchy, which, like Branting's reduction graphs, links more and less abstract factors. However, while Branting has a different graph for each case, expressing the justification of the case's decision, CATO has just one hierarchy, expressing expert knowledge about the domain. In CATO's hierarchy lower factors are labelled according to whether they are a reason pro or con the higher factors they are linked to. Links are labelled according to their strength (weak or strong), which labels can be used to solve certain conflicts. Cases are, as in HYPO, still represented as one-step decisions, but users of CATO can use the factor hierarchy in several ways for interpreting the theory behind a decision. For instance, it is possible to discuss the relevance of a distinction, i.e., to argue why in the current situation the decision should

be different, due to the distinction, or why it should be the same, in spite of it. The corresponding argument moves are called emphasizing and downplaying a distinction.

Emphasizing a distinction consists not only in pointing at the factual differences, but also in stressing that, according to the factor hierarchy, the additional or missing distinctive factors allow the construction of a multi-step argument why the distinction matters. For instance, assume a factor hierarchy for our tax example in which (see Figure 1) two basic factors *kept house* and *kept old car number plate* are both positively linked to the more abstract factor *showed intention to return*, which in turn is negatively linked to *change*.

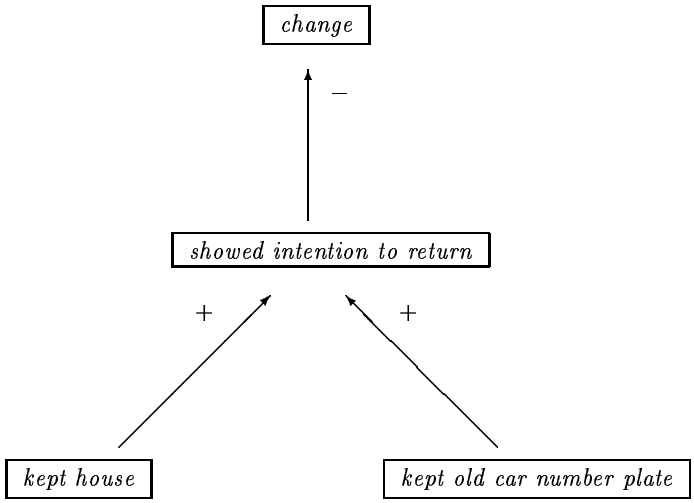

Figure 1. A partial factor hierarchy

And assume the following precedent.

Prec D: Factors: *short duration*, *kept house*
Decision: no change

Assume, furthermore, that the current fact situation is

CFS1: *short duration*

HYPO allows to distinguish precedent D by pointing at the factor *kept house* of Prec D, which is missing in the CFS. CATO allows in addition to emphasize this distinction, by saying that therefore in the CFS no intention to return was shown, unlike in precedent D. Thus the significance of the distinction is explained in terms of the factor hierarchy.

If, moreover, the CFS contains a factor con *showed intention to return*, CATO would have mentioned this as well, to draw an even stronger contrast between the cases.

Downplaying a distinction exploits the hierarchy in a different way. It consists in saying that in spite of the apparent distinction between the cases at the factual level, at a more abstract level a parallel can be drawn. Assume that the facts are now as follows.

CFS2: *short duration*, *kept old car number plate*

If now Prec D is distinguished since the CFS lacks D's factor *kept house*, then this distinction can be downplayed by referring to the factor hierarchy, by saying that both in Prec D and in the CFS there is evidence that *showed intention to return*. (The reader will have recognized that downplaying a distinction in fact employs the abstraction type of analogy, discussed above in Section 2.2.1.)

In our model we want to include the possibility of a factor hierarchy, but we shall not try to directly model downplaying and emphasizing a distinction, since the different aims of our model and of CATO (which is a tutoring system) seem to prevent a straightforward inclusion of these moves in our approach. Instead we shall briefly indicate how aspects of these moves, and of abstraction type analogy, could be added in future research. In some respects we also want to extend and generalize CATO's approach. In particular, while CATO's factor hierarchy is fixed, we want to be able to assert multiple view points on the factor hierarchy and on the priorities between factors, and to make those priorities dependent upon arguments.

4. The Building Blocks of our Proposal

In this section we present the main ingredients of our proposal. After a sketch of the main ideas (4.1.), we outline some basic notions of our previously developed logical argumentation system (4.2.), introduce a new method for representing precedents (4.3.), and present the dialectical form of our argumentation system (4.4).

4.1. The Basic Idea

As already indicated, we want to present, within the analysis of Section 2, a logic-based model of dialectical case-based reasoning that preserves some strong points of the above CBR systems, but that also extends and generalizes them in some respects. Let us briefly summarize the basic requirements which our model intends to satisfy.

- As for the *dialectical setting*, we want to model the idea of normative dialectics: rules for dispute should reflect dialectical asymmetry between the proponent and the opponent of a claim, and the aim of the dispute is to test whether a claim is tenable.

- As for the basic *argument moves*, they should contain broadening and restrictive and non-restrictive distinguishing as modelled in HYPO, they must allow the use of portions of precedents (as in Branting's model), and they must allow for broadening and discrediting legal rules (as in CABARET).

- As for *representing precedents*, it should be possible to represent multi-step arguments (as in Branting's proposal), dialectical structures, i.e., arguments and counterarguments (as in HYPO and CATO), and multi-level arguments, i.e., arguments on rule-priorities.

- Finally, as for *comparing arguments*, we want to retain HYPO's more-on-point ordering as one of the criteria, but leave room for any other criterion. And the criteria must be debatable, just as any other legal claim.

We shall try to satisfy these requirements with the following three main ideas. Firstly, the dialectical setting will be captured by the dialectical proof theory for defeasible argumentation defined in (Prakken & Sartor, 1996b, 1997a). This proof theory embodies the idea of normative dialectics: it has the form of a dialogue game between a proponent and an opponent for a claim, and its output is whether the claim is justified, defensible or overruled. However, its assumption that there is a fixed pool of premises will be replaced by certain ways to introduce new premises, which is our second main idea. In particular, we shall model two argument moves, broadening and non-restrictive distinguishing, as heuristics for introducing new premises into a dispute. It is important to note that our original proof theory now applies to each stage in a dispute, evaluating it in a manner to be defined below in subsection 5.4. Our final idea is a new case representation method, adapting an idea of Loui & Norman (1995): each precedent will be represented not just as one logical argument but as a set of possibly conflicting arguments. Each of those arguments may include multiple steps (as Branting suggests), but the conclusion derived in each of those steps may be the matter of a dispute in which factors pro and con that conclusion are resolved (as in HYPO). Moreover, our representation shall include arguments on rule priorities, to express that (and sometimes also why) certain factors were outweighed by other factors.

4.2. Logical Preliminaries

The logical background assumed in this paper is the argument-based system of Prakken & Sartor (1996a; 1996b; 1997a) (although other systems with similar features will do as well). In this section we briefly describe the basic elements of the system, except its dialectical form, which will be discussed below in subsection 4.4. The logical language is that of extended logic programming. i.e., it has both negation as failure ($\sim$) and classical, or strong negation ($\neg$). We add to this language one feature: each formula is preceded by a term, its name. Rules are *strict*, represented with $\rightarrow$, or else *defeasible*, represented with $\Rightarrow$. The idea is that strict rules are beyond debate; only defeasible rules can make an argument subject to defeat. Accordingly, facts are represented as strict rules with empty antecedents (e.g. $\rightarrow$ *gave-up-house*). The input information of the system, i.e., the premises, is a set of strict and defeasible rules, which we call an *ordered theory* ('ordered' since, as explained below, we assume an ordering on the defeasible rules).

The following notions are all defined relative to a given ordered theory. Arguments can be formed by chaining rules, ignoring weakly negated antecedents; each head of a rule in the argument is a conclusion of the argument. Conflicts between arguments are decided according to a binary relation of *defeat* among arguments, which is partly induced by rule priorities. An important feature of our system is that the information about these priorities is itself presented as premises in the logical language, as in the following two example rules.

r: r_1 *is decided by higher court than* $r_2 \Rightarrow r_2 \prec r_1$

r': r_1 *protects manufacturers* $\wedge$ r_2 *protects consumers* $\wedge$ *consumer runs higher risks than manufacturer* $\Rightarrow r_1 \prec r_2$

Here $x \prec y$ means that y is preferred over x. Thus rule priorities are like any other piece of legal information established by arguments, and may be debated as any other legal issue.

Our relation of *defeat* is a weak notion: that Arg_1 defeats Arg_2 does not exclude that Arg_2 also defeats Arg_1; this can happen, for instance, when a conflict between two incompatible rules is not resolved by the given rule priorities. If, however, Arg_1 defeats Arg_2 but not vice versa, we say that Arg_1 *strictly defeats* Ag_2.

There are three ways in which an argument Arg_2 can defeat an argument Arg_1. The first is *undercutting* it, which occurs if a rule in Arg_1 contains $\sim L$ in its body, while Arg_2 has a conclusion L. For instance, the argument $[r_1\colon \rightarrow p,\ r_2\colon p \Rightarrow q]$ (strictly) defeats the argument $[r_3\colon \sim q \Rightarrow r]$ by undercutting it (note that $\sim L$ reads as

'there is no evidence that L'). The other two forms of defeat are only possible if Arg_1 does not undercut Arg_2. One way is by *excluding* an argument, which happens when Arg_2 concludes for some rule r in Arg_1 that r is not applicable (formalized as $\neg appl(r)$). For instance, the argument $[r_1\colon \rightarrow p,\ r_2\colon p \Rightarrow \neg appl(r_3)]$ (strictly) defeats the argument $[r_3\colon \Rightarrow r]$ by excluding it. The final way in which Arg_2 can defeat Arg_1 is by *rebutting* it: this happens when Arg_1 and Arg_2 contain rules that are in a head-to-head conflict and Arg_2's rule is not worse than the conflicting rule in Arg_1. For instance, the arguments[7]

$[f_1\colon$ *short-duration,* r_1*: short-duration* $\Rightarrow$ *change-fiscal-domicile*$]$
$[f_2\colon$ *foreign-company,* r_2*: foreign-company* $\Rightarrow$
$\neg$ *change-fiscal-domicile*$]$

defeat each other if the rules r_1 and r_2 are of equal priority or if no priority relation holds between them, while the first strictly defeats the second if r_1 has priority over r_2.

The defeat relation is not yet the final assessment of arguments: since it is just a comparison between two individual arguments, it does not capture the phenomenon of 'reinstatement'. To illustrate this notion, assume that an argument A is strictly defeated by an argument B, which in turn is strictly defeated by an (undefeated) argument C; then intuitively C reinstates A. This is captured by the final element of our system, which, taking all interactions between the possible arguments into account, divides these arguments into three classes: the *justified* arguments, those with which a dispute can be 'won', the *overruled* arguments, with which a dispute should be 'lost', and the *defensible* arguments, which should leave the dispute undecided (recall that these notions are relative to a given ordered theory). The proof-theoretical version of his definition has the form of a dialogue game, and will be discussed below in subsection 4.4.

4.3. A Method for Representing Cases

Our method for representing legal precedents has two components: representing the tendency of a factor in a logical rule, and representing a precedent with conflicting factors as a set of conflicting logical arguments. As for the tendency of factors, this is represented as follows. A rule 'f is a reason pro d' is represented as a rule

$$r : f \Rightarrow d$$

We may also have a conjunctive reason, as in the following rule.

$r : f_1 \wedge f_2 \Rightarrow d$

As for representing precedents, above we said that we want to represent them as collections of, possibly conflicting, arguments. In fact we shall for notational convenience present them in a slightly simpler way, viz. as sets of rules from which the arguments pro and con can be constructed. The precise method is as follows. Since we want to read a rule *antecedent* $\Rightarrow$ *consequent* as saying that the antecedent is a reason for the consequent, we cannot express a dominance of, say, the pro factors over the con factors by conjoining pro and con reasons in the antecedent of a rule with the pro consequent. Instead we use a representation which directly expresses the tendency of each factor, and the resolution of their conflict. The simplest of such formalizations consists in separately representing each reason statement, and adding one or more rules concerning their comparative evaluation.

For example, let us assume that a short duration of the working stay outweighs the fact that the company is foreign. We do not express that by a combined rule

r: *short-duration* $\wedge$ *foreign-company* $\Rightarrow \neg$ *change-fiscal-domicile*

Instead, we represent the resolution of the conflict as a pair of conflicting rules, together with a priority statement.

r_1: *short-duration* $\Rightarrow \neg$ *change-fiscal-domicile*
r_2: *foreign-company* $\Rightarrow$ *change-fiscal-domicile*
r_3: *antecedent* $\Rightarrow r_2 \prec r_1$

Here *antecedent* expresses the reasons why *short-duration* outweighs *foreign-company* (as far as a change in fiscal domicile is concerned). In realistic examples *antecedent* will itself often be derived (dialectically) from other rules. In fact, one major advantage of this representation scheme is that it makes it possible to express the grounds why certain factors override certain other factors, in the form of antecedents of priority rules. See, for instance, the two priority rules in Subsection 4.2., that had antecedents r_1 *is decided by higher court than* r_2 and r_1 *protects manufacturers* $\wedge$ r_2 *protects consumers* $\wedge$ *consumer runs higher risks than manufacturer*. As these examples show, the priorities can be based on any ground, ranging from general legal principles to case-specific considerations. It is not necessary (although possible) that they reflect certain general legal principles, like 'higher courts precede lower courts' or 'later decisions prevail over earlier ones'. And the priorities can very well depend on considerations that are specific to the context

of a case, as in the above rule antecedent about manufacturers and consumers.

Finally, as usual in legal theory, we assume that precedents contain general rules, i.e., that they contain variables instead of ground terms (except for the priority rule of a case).

4.4. The Dialectical Context

Just defining a representation method in a logical language is not enough; we must also specify the dialectical context in which the represented information can be used. As indicated in Section 4.1., we want to embed our representation method in the dialectical proof theory that was developed in Prakken & Sartor (1996b,1997a) for the just-explained system for defeasible argumentation, but we want to replace its assumption that there is a fixed pool of premises (the ordered theory) with ways of entering new information into a dispute. We now present the dialectical proof theory; in the following section it will be embedded in a protocol for premise introduction. For more technical details on the proof theory and related work of others the reader is referred to (Prakken & Sartor, 1997a) and (Prakken, 1998).

The proof theory has the form of a dialogue game. Its purpose is to determine whether a given formula defeasibly follows from a given ordered theory or not, i.e., whether it is a justified conclusion on the basis of the ordered theory or not. Thus the game is an example of normative dialectics, with the resulting dialectical asymmetry between the players. A proof that a formula is justified takes the form of a dialogue tree, where each branch of the tree is a dialogue, and the root of the tree is an argument for the formula. Every move in a dialogue consists of an argument based on some given ordered theory. Each stated argument attacks the last move of the opponent in a way that meets the player's burden of proof. The required force of a move depends on who states it. Since the proponent wants a conclusion to be justified, a proponent's move has to be strictly defeating, while since the opponent only wants to prevent the conclusion from being justified, an opponent's move may be just defeating. A subtlety here is that for determining the force of the proponent's move only the priorities stated by that move count, while for assessing the opponent's move no priorities need to be applied at all.

Here is the central definition of the dialogue game ('Arg-defeat' means defeat on the basis of the priorities stated by Arg).

DEFINITION 4.1. (dialogues) A *dialogue* is a finite nonempty sequence of moves $move_i = (Player_i, Arg_i)$ $(i > 0)$, such that

1. $Player_i = P$ iff i is odd; and $Player_i = O$ iff i is even;
2. If $Player_i = Player_j = P$ and $i \neq j$, then
   $Arg_i \neq Arg_j$;
3. If $Player_i = P$ then Arg_i is a minimal (w.r.t. set inclusion) argument such that
   a) Arg_i strictly Arg_i-defeats Arg_{i-1}; or
   b) Arg_{i-1} does not Arg_i-defeat A_{i-2};
4. If $Player_i = O$ then Arg_i $\emptyset$-defeats Arg_{i-1}.

A dialogue is based on a set of rules Γ iff all rules of Arg_i are in Γ.

The first condition says that the proponent begins and then the players take turns, while the second condition prevents the proponent from repeating a move. The last two conditions form the heart of the definition: they state the burdens of proof for P and O. Condition (3) gives P two types of moves: the first is an argument that combines an attack on O's move with a priority argument that makes the attack succeed; the second is a priority argument that neutralizes the defeating force of O's last move. Finally, condition (4) says that O does not have to take priorities into account.

The following simple dialogue illustrates this definition (the rule names refer ahead to the example below in Section 6.4.).

P_1: [f_1: *kept-house*,
r_1: *kept-house* $\Rightarrow \neg$ *change*]

O_1: [f_{10}: $\neg$ *domestic-headquarters*,
r_{10}: $\neg$ *domestic-headquarters* $\Rightarrow \neg$ *domestic-company*,
r_4: $\neg$ *domestic-company* $\Rightarrow$ *change*]

P_2: [f_7: *domestic-property*,
r_7: *domestic-property* $\Rightarrow$ *domestic-company*,
f_{16}: r_7 *is decided by higher court than* r_{10},
p: r_7 *is decided by higher court than* $r_{10} \Rightarrow r_{10} \prec r_7$]

The proponent starts the dialogue with an argument P_1 for $\neg$ *change*, after which the opponent attacks this argument with an argument O_1 for the opposite conclusion. O_1 has the required defeating force, since

in our logical system two rebutting arguments defeat each other if no priorities apply to the conflict. P_2 illustrates the first possible reply of the proponent to an opponent's move: it combines a 'normal' argument with a priority argument that makes it strictly defeat the opponent's move. The second possibility, just stating a priority argument that neutralizes the opponent's move, is illustrated by the following alternative move:

P_2': $[f_{17}$: r_1 *is more recent than* r_4,
p': r_1 *is more recent than* $r_4 \Rightarrow r_4 \prec r_1]$

The point of this argument is to resolve the conflict between P_1 and O_1 in favour of P_1.

Next we recapitulate the definition of a 'dialogue tree'.

DEFINITION 4.2. (dialogue trees) A *dialogue tree* based on an ordered theory Γ is a tree of moves such that

1. Each branch is a dialogue based on Γ;
2. If $Player_i = P$ then the children of $move_i$ are all defeaters of Arg_i based on Γ.

The second condition of this definition makes dialogue trees candidates for being proofs: it says that the tree should consider all possible ways in which O can defeat a move of P. This is why the definition is relative to an ordered theory. (Note that the definition further allows that P-nodes have several children). The above example has (assuming there are not more premises) a dialogue tree of two dialogues, $P_1 - O_1 - P_2$ and $P_1 - O_1 - P_2'$.

The final definition summarizes when a player has won a dialogue and when an argument and claim has been shown justified.

DEFINITION 4.3. (winning) A player *wins a dialogue* based on Γ iff the other player cannot move. P *wins a dialogue tree* based on Γ iff he wins all its branches. And O wins it iff he wins one of its branches. An argument A is *justified* on the basis of Γ iff there exists a dialogue tree based on Γ with A as root and won by P. And, based on Γ, an argument is *overruled* iff it is defeated by a justified argument, and it is *defensible* iff it is neither justified nor overruled. Finally, a claim C is a *justified conclusion* on the basis of Γ iff there is a justified argument for C based on Γ.

Figure 2 illustrates the dialectical proof theory with two dialogue trees, where the ordered theories, and the contents of the arguments are left

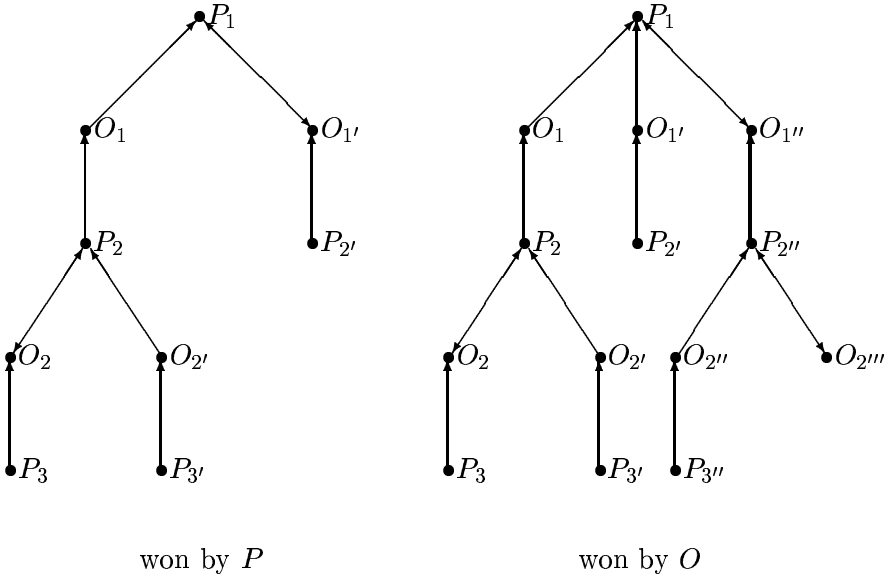

Figure 2. Two dialogue trees

implicit. The tree on the right extends the tree on the left with one new branch, made possible by adding new premises to the ordered theory. Arrows stand for defeat relations, so one-directional arrows stand for strict defeat and bidirectional arrows for mutual defeat. The dialectical asymmetry between P and O is reflected by the fact that all arrows from P's moves to O's moves are one-directional, while some arrows from O's moves to P's moves are bidirectional. Assuming that the trees cannot be extended with new arguments, the tree on the left is won by P, since all its branches end with a move by P, so P_1 is a justified argument; by contrast, the tree on the right is won by O, since one of its branches ends with a move by O, so here P_1 is not justified.

This completes the overview of the dialogue game. In (Prakken & Sartor, 1997a) we prove that as a proof theory it is sound and under certain finiteness conditions also complete with respect to the fixpoint semantics defined in (Prakken & Sartor, 1996a). Since this semantics is a special case of the general framework of Dung (1995) and Bondarenko et al. (1997), these results give our dialogue game a well-understood logical foundation. In particular, they imply that the dialogue game has some desirable properties. For present purposes the most important of them are that the set of all justified conclusions is consistent, that the rule ordering derived from these conclusions (and that also determines these conclusions) is a strict partial order, and that the system satisfies

the 'weakest link' principle that an argument can only be justified if all its subarguments are also justified.

5. A Protocol for Reasoning with Precedents

The just-described dialogue game is defined relative to an arbitrary but fixed ordered theory. This is fine as long as the game serves as a nonmonotonic proof theory, but when applied to the modelling of disputes, this is different, since in actual disputes the premises are provided dynamically, in dialectical interaction between the parties. However, in (Prakken & Sartor, 1996b) we remarked that the dialectical proof theory also applies if the pool of premises is assumed to consist of everything put forward by the parties in a dialogue. In the present section we want to make this precise. More specifically, we want to regard HYPO-style reasoning with precedents as heuristics for introducing information into a dispute, where each premise introduction is contained in an argument that satisfies the player's burden of proof as defined in Definition 4.1.

We shall discuss four things: the background information from which premises can be constructed, reasoning with precedents, conducting actual disputes, and evaluating them. It should be noted beforehand that the protocol is not meant to be exhaustive: it does not want to capture all possible argument moves, but only some of them, viz. HYPO-style reasoning with precedents.

5.1. The Background Information

We describe the protocol relative to a background theory of precedents, facts and eventual other information. To this end we now first formally define the notion of a precedent.

DEFINITION 5.1. (precedents) A *precedent Case* is a pair *(CaseFacts, CaseRules)*, where

- *CaseFacts* is a set of strict rules;
- *CaseRules* is a set of rules.

If *Cases* is a set of precedents, then *Rules-of-Cases* is the union of the sets *CaseRules* of all precedents in *Cases*.

Recall that in our model a precedent can be conceived in two ways, as consisting of premises (facts and rules), or as consisting of arguments. The arguments in a precedent $Case = (CaseFacts, CaseRules)$ are

exactly all those which can be built from the ordered theory (*CaseFacts, CaseRules*). This means that those arguments can with Definition 4.3 be classified as justified, defensible, or overruled on the basis of $\Gamma =$ *Case*. We believe that these notions may be relevant for the theory of precedent, in particular for the distinction between rationes decidendi and obiter dicta: the notion of a ratio decidendi of a case can be linked to that of (the rules in) a justified argument, while that of an obiter dictum can be linked to that of (the rules in) a non-justified one.

Next we define the 'background information' of the protocol. This should not be confused with the ordered theory of our system for defeasible argumentation: the background information is the information from which the ordered theory can be (dialectically) constructed by the parties. It consists of a set of precedents, a set of 'common-sense' rules, which might also include the applicable law (as in CABARET) or a factor hierarchy (as in CATO), and a set of strict rules, representing the current fact situation.

DEFINITION 5.2. (Background Information) A *Background Information theory (BI)* is a triple *(Cases,CFS,CSRules)*, where

- *Cases* is a set of precedents;
- *CFS* is a set of strict rules, the current fact situation;
- *CSRules* is a set of rules, the 'common sense' knowledge.

5.2. Reasoning with Precedents

How can the background information be used to introduce information into a debate? As a first approximation the idea is that each move of the players should only consist of rules from *Rules-of-Cases*, *CFS* and/or *CSRules* (obviously, the facts of a precedent can in a new fact situation not be used). However, to capture HYPO-style reasoning, we must also allow for the introduction of rules that are not contained in any of these three sets but that can be obtained by analogizing or distinguishing a precedent.

First we define how these kinds of reasoning can result in new rules. Informally, the idea is that given a pre-existing (defeasible) rule we can produce two types of rules: broadening rules, which have the same consequent as a pre-existing rule but lack one or more of its antecedents, and distinction rules, which state that the omitted antecedents are necessary for warranting that consequent. [8]

We also use the following notation: for any rule r the set of literals occurring in its antecedent is denoted by $AntLits(r)$, while its

antecedent and consequent are denoted by $ANT(r)$ and $CONS(r)$. And for any set $R = \{r_1, \ldots, r_n\}$ of rules, $AntLits(R) = AntLits(r_1) \cup \ldots \cup AntLits(r_n)$; likewise for $ANT(R)$ and $CONS(R)$.

We now define how to broaden a rule. The idea is simple: a rule can be broadened by deleting one or more of the literals in its antecedent.

DEFINITION 5.3. (broadening a rule). A defeasible rule r *broadens* a defeasible rule r' iff

1. the first argument of r's name is r'; and
2. r and r' have the same consequent; and
3. $AntLits(r) \subseteq AntLits(r')$.

In our model we allow two forms of distinguishing, which can be called weak and strong distinguishing.[9] Weak distinguishing just concludes to the inapplicability of a broadening rule, i.e., it excludes the argument using that rule, while strong distinguishing argues that the opposite conclusion holds, i.e., it rebuts the argument using the broadened rule. The precise definition is technically more involved than the one of broadening, but the basic idea is simple. If the other party has broadened a rule by omitting one or more literals in its antecedent, then one can strongly distinguish by saying that if the omitted literals cannot be proven, the opposite conclusion holds, and one can weakly distinguish by saying that then the broadening rule is inapplicable. This is formalized by giving the following content to a distinction rule d concerning a broadening b. The antecedent of d contains the weak negations of the literals that were omitted in b, and the consequent of d is either the complement of b's consequent (strong distinguishing) or of the form $\neg appl(r)$ (weak distinguishing).

DEFINITION 5.4. (distinguishing a rule). A defeasible rule r *strongly distinguishes* a defeasible rule r' iff

1. r and r' have contradictory consequents; and
2. there exists a defeasible rule r'' broadened by r' and there exist literals $L_1, \ldots L_n$ such that
   a) $L_1, \ldots L_n$ are included in $ANT(r'')$ but not in $ANT(r')$;
   b) $ANT(r) = \sim L_1 \wedge \ldots \wedge \sim L_n (n > 0)$.

A rule r *weakly distinguishes* a rule r' iff

1. The consequent of r is $\neg appl(r')$; and

2. Condition (2) of strong distinguishing holds.

Note that the antecedent of the distinguishing rule is a conjunction of weak literals $\sim L_1 \wedge \ldots \wedge \sim L_n$: thus the distinction says that if $L_1 \wedge \ldots \wedge L_n$ are not proved, then the consequent of the attacked broadening (and of the original rule) does not hold. The literals $L_1 \wedge \ldots \wedge L_n$ are exactly those literals which were cancelled from the original rule r'' in order to produce the broadening r'. In other words, when distinguishing, one claims that without the missing conditions (required by the original rules and omitted in the broadening) the conclusion of the broadened rule does not hold.

To give a simple example, assume that a case has a rule[10]

$$r'': \quad a \wedge b \Rightarrow c$$

and assume that r'' is broadened by deleting b from r'''s antecedent, resulting in

$$r': \quad a \Rightarrow c$$

Then r' can be strongly distinguished by weakly negating the missing literal b and adding it to the antecedent of a rule with a consequent opposite to that of r':

$$r: \quad \sim b \Rightarrow \neg\, c$$

Correspondingly, r' can be weakly distinguished by a rule with the same antecedent but with a consequent stating that r' is inapplicable.

$$r: \quad \sim b \Rightarrow \neg\, \mathit{appl}(r')$$

Here is a final example. Consider the rule

$$r_{2/4/6}: \quad \neg\, \mathit{kept\text{-}house} \wedge \neg\, \mathit{domestic\text{-}company} \wedge \mathit{long\text{-}duration} \Rightarrow \mathit{change}$$

The following rule broadens $r_{2/4/6}$:

$$r_{4/6}: \quad \neg\, \mathit{domestic\text{-}company} \wedge \mathit{long\text{-}duration} \Rightarrow \mathit{change}$$

while the following rule (strongly) distinguishes $r_{4/6}$:

$$r_{d2}: \quad \sim \neg\, \mathit{kept\text{-}house} \Rightarrow \neg\, \mathit{change}$$

Note that our definition of distinguishing only covers non-restrictive distinguishing, i.e., cases where the *CFS* misses some factors of the precedent; restrictive distinguishing, i.e., emphasizing a new factor not present in the precedent, can be modelled by adding knowledge about the tendency of factors to *CSRules*: for each *factor* for *supported conclusion* we can add a rule

r: *factor* $\Rightarrow$ *supported conclusion*

to *CSRules*. Any such rule can, when its antecedent is satisfied, be cited to counter a conflicting precedent rule. Finally, HYPO's notion of a counterexample, i.e., citing a case with the missing factor and the opposite outcome, is captured in our model by the possibility of simply using the counterexample as a counterargument, as will be illustrated below in Section 6.4.

5.3. Actual Disputes

As stated several times above, our dialogue game of Section 4.4. serves as a (dialectical) proof theory, and therefore it assumes a fixed set of premises. In the present section, however, we are concerned with actual disputes, i.e., disputes in which the set of premises is constructed dynamically, during the dispute. Accordingly, we now define the notion of an actual dialogue, i.e., a dialogue as it can actually evolve between the parties in a dispute. This boils down to defining the precise content of the ordered theory Γ referred to in Definition 4.1.

We first define some useful notation. Let us denote for any $BI =$ (*Cases, CFS, CSRules*) the set of all broadenings of any rule in *Rules-of-Cases* with $Broadenings_{BI}$ (note that *Rules-of-Cases* $\cup$ *CSRules* $\subseteq Broadenings_{BI}$) and the set of all rules distinguishing any rule in $Broadenings_{BI}$ with $Distinctions_{BI}$. Then we define the introducible rules (on the basis of BI) as follows.

DEFINITION 5.5. (introducible rules).

$$Introducibles_{BI} \supseteq Broadenings_{BI} \cup Distinctions_{BI}.$$

Thus the set of introducible rules does not only contain all rules of any case in $Cases_{BI}$ but also all rules that can be formed by broadening any of those rules, and by distinguishing any of those broadenings. Note that this definition does not say that the set of introducible rules is equal to the possible broadenings and distinctions, but instead that these broadenings and distinctions are a subset of the set of introducible rules. Together with the following definition this formalizes that our protocol leaves room for other ways of introducing premises into a dispute.

We can now define an actual dialogue, and the corresponding notion of an actual dialogue tree, as follows. The idea is that an actual dialogue conforms to the definition of a dialogue game in Definition 4.1 with one important difference: the rules in an argument do not have to be directly contained in a given set of rules; they may also be constructed from these rules by broadening or distinguishing (or they may be defined introducible in some other way).

DEFINITION 5.6. (actual dialogues) For any BI

- An *actual dialogue* based on BI is a dialogue D conforming to Definition 4.1 and based on $CFS \cup CSRules \cup Introducibles_{BI}$.
- An *actual dialogue tree* based on BI is a tree of actual dialogues based on BI.

Note that we do not require that an actual dialogue tree contains all possible moves of the opponent.

An actual dialogue tree should not be confused with a dispute as it actually takes place. Rather, such a tree is a data structure which is built by the moves of the parties in a dispute. Below we assume that a disputational protocol exists for constructing an actual dialogue tree. However, since various such protocols are conceivable (e.g. 'extend all nodes at once' or 'extend one node'), we shall not define a particular one. We confine ourselves to observing that any such protocol should allow for 'backtracking', i.e., for extending not only the leaves of the tree but also earlier nodes. This is necessary since it may be that a player's move introduces premises with which the other player can construct a new counterargument against an earlier move of the first player (this cannot happen in the dialectical proof theory of Section 4.4., where the ordered theory Γ is fixed).

5.4. Winning a Dispute

Finally we define the outcome of a dispute. Assume that after $move_i$ in a dispute an actual dialogue tree T_i is constructed. Then the question is, who is winning at stage i, if any? Our answer should maintain the link with Definition 4.3 and thus with the semantics of (Prakken & Sartor, 1997a). Now Definition 4.3 is relative to a given ordered theory, while the idea of our actual dialogues is that this ordered theory is constructed dynamically. So we have to define what the content is of the set Γ referred to in Definition 4.3.

Since in the present paper we focus on reasoning with precedents, we assume for convenience that *CFS* and *CSRules* are fixed, i.e., that Γ

at least contains these sets (although in other reasoning contexts they might also be constructed dynamically). Then two alternative contents of Γ suggest themselves. The first contains besides these sets all rules that are introducible: i.e.,

(1) $\Gamma = \mathit{CFS} \cup \mathit{CSRules} \cup \mathit{Introducibles}_{BI}$

The second only contains the introducible rules that have actually been introduced into the dispute. Accordingly, we now index Γ with the stage of the dispute (for any tree T of moves, Rules_T is the set of all rules occuring in T).

(2) $\Gamma_i = \mathit{CFS} \cup \mathit{CSRules} \cup \mathit{Rules\text{-}of\text{-}Cases} \cup (\mathit{Introducibles}_{BI} \cap \mathit{Rules}_{T_i})$

These definitions differ in the following way. The first formulates an *ideal* standard for disputes, requiring that the parties analogize and distinguish the available precedents in the best possible ways. It does so because of the requirement in Definition 4.2(2) that a dialogue tree contains all possible moves of the opponent. When combined with clause (1) just given, this means in particular that a dialogue tree contains all possible distinctions that an opponent can make. The second definition, by contrast, evaluates debates relative to the analogies and distinctions that have actually been made, since it only includes in T_i those broadenings and distinctions that have actually been introduced by one of the parties upto T_i.

In our opinion there is no need to choose which is the 'right' definition; both definitions may have their uses, depending on the context.

Finally, we can define the notion of winning an actual dialogue tree (leaving the content of Γ ambiguous between (1) and (2)). The definition directly states the link with the proof theory of Definition 4.3 and thus indirectly with the semantics of Prakken & Sartor (1997).

DEFINITION 5.7. (actually winning) For any actual dialogue tree T_i:

1. P wins T_i if there is a dialogue tree on the basis of Γ_i with the same root as T_i, won by P, and containing only arguments of T_i;
2. O wins T_i if there is no dialogue tree on the basis of Γ_i with the same root as T_i, won by P;
3. otherwise, T_i is undetermined.

It is desirable to restate this definition in terms of the structure of T_i, so that for checking the result no new dialectical proof tree has to be

constructed. It is easy to see that P wins T_i iff, by breaking off only branches after a move by O (so at a choice point for P), T_i can be pruned into a dialogue tree T_i' of which all leaves are P-moves and that cannot be extended after any P-move without introducing new premises. For a win by O similar conditions on the structure of T_i can be given. Observe also that if Γ_i is defined as in (1) above, the words 'without introducing new premises' can be omitted.

It is important to note that when the proponent uses a broadening rule, this rule can always be distinguished by the opponent. Therefore, if the opponent makes optimal use of its resources, a proponent can only win a debate if it does not draw analogies. This seems realistic, since with analogies the decision whether to regard the similarities or the differences as more important is in the end a matter of substance rather than of logical form.

At first sight, this observation would seem to reveal a drawback of our model, since it would seem to imply that whenever the parties disagree, we cannot say that a precedent 'controls a case'. Yet this is not true: the key is to take the third, procedural level of legal argument into account. Our present model addresses the fourth layer, i.e., it studies heuristics for premise introduction. However, in legal reality disputes take place in the context of a legal procedure, and such a procedure defines, among other things, how an actual dispute terminates, and how an arbiter (the judge) has the procedural power to evaluate the introduced arguments, for instance to decide whether the similarities or the differences between two cases are more important. Now the crucial observation is that such an evaluation could be modelled as a (final) premise introduction, viz. as one or more priority arguments, after which Definition 5.7 can be used once more to compute the final outcome. In sum, a full model of reasoning with precedents should also address the procedural aspects of legal reasoning (as argued before by Hage *et al.*, 1994 and Gordon, 1995 and also by Berman & Hafner, 1991).

6. Applying the Protocol

In this section we illustrate how our dialectical protocol can be applied to HYPO-style reasoning with precedents. We first discuss the adaptation of HYPO's more-on-point ordering to our model, then explain some subtleties concerning distinguishing and combining factors, and then present an example. Readers wishing to avoid too many technicalities can immediately proceed to Subsection 6.4.

6.1. On-pointness

In our model we want to use HYPO's similarity ordering on cases (the 'more on point' ordering) as one of the sources of rule priorities (note that in HYPO it is used for other things, such as selecting the best case to cite). In particular, if two counterarguments cite rules from different cases, we want to give priority to the rule from the case that is more similar to the current situation. However, it is not obvious whether we can directly apply HYPO's more-on-point ordering, since this ordering was not defined for multi-steps precedents. In (Prakken & Sartor, 1997b) we promised that the present article would redefine HYPO's definition. However, the problem has turned out to be more complex than we then realized, and therefore we now confine ourselves to identifying the problems and briefly indicating possible solutions.

Recall that HYPO's definition of the more-on-point ordering has two elements. Firstly, it defines the on-pointness of a precedent as being the overlap between the facts of the precedent and the current fact situation; and secondly, it determines which precedent is more on point by ordering the various overlaps in terms of set inclusion: precedent A is more on point than precedent B, if A's overlap with the current situation is a superset of B's overlap. As for the second element, we shall model it in the same way as in HYPO, i.e. according to set inclusion. However, as for the first element, determining the overlap between the precedent and the current situation, it is not obvious that we can, as in HYPO, simply intersect all 'input' facts of the precedent with the *CFS*. The reason is that our multi-steps representation allows the citation of *portions* of precedents, i.e., the citation of a precedent not only for its final decision but also for its intermediary ones. This has two important consequences for determining on-pointness. When a case is decided with a multi-steps argument:

- the court often considers an input fact in only some of these steps; so whether a case fact is relevant depends on the (sub)decision for which the case is cited;

- in 'later' steps the court often considers not just facts but also the conclusions of 'earlier' steps, acting as 'facts' for a later decision; so on-pointness often depends not only on the facts of a case, but also on intermediate conclusions of a precedent.

Let us illustrate this with an example. Assume we have two conflicting precedents A and B. (The rule names refer ahead to the example in Subsection 6.4.)

$A =$ $\{r_7$: *domestic-property* $\Rightarrow$ *domestic-company*,
$r_{10/12}$: $\neg$ *domestic-headquarters* $\wedge$ $\neg$ *domestic-president*
$\Rightarrow$ $\neg$ *domestic-company*,
$r_{4/6}$: $\neg$ *domestic-company* $\wedge$ *long-duration* $\Rightarrow$ *change*,
r_1: *kept-house* $\Rightarrow$ $\neg$ *change*,
p_1: $\Rightarrow r_7 \prec r_{10/12}$,
p_2: $\Rightarrow r_1 \prec r_{4/6}$,
f_1: *kept-house*, f_6: *long-duration*,
f_7: *domestic-property*, f_{10}: $\neg$ *domestic-headquarters*,
f_{12}: $\neg$ *domestic-president*$\}$

A has an intermediate decision $\neg$ *domestic-company* and a final decision *change*.

$B =$ $\{r_{7/9}$: *domestic-property* $\wedge$ *domestic-headquarters* $\Rightarrow$
domestic-company,
r_3: *domestic-company* $\Rightarrow$ $\neg$ *change*,
r_2: $\neg$ *kept-house* $\Rightarrow$ *change*,
p_1: $\Rightarrow r_2 \prec r_3$,
f_2: $\neg$ *kept-house*, f_9: *domestic-headquarters*,
f_7: *domestic-property*$\}$

B has an intermediate decision *domestic-company* and a final decision $\neg$ *change*.

Consider, furthermore, the following current fact situation.

$CFS =$ $\{f_2 :$ $\neg$ *kept-house*, f_7: *domestic-property*,
$f_{10} :$ $\neg$ *domestic-headquarters*$\}$

Assume that A is cited by the proponent in a dispute as follows, broadening $r_{10/12}$ into b_{10} and $r_{4/6}$ into b_4.

$P_i =$ $\{b_{10}$: $\neg$ *domestic-headquarters* $\Rightarrow$ $\neg$ *domestic-company*,
b_4: $\neg$ *domestic-company* $\Rightarrow$ *change*
f_{10}: $\neg$ *domestic-headquarters*$\}$

And assume that the opponent replies by citing B as follows, broadening $r_{7/9}$ into b_7.

$$\begin{aligned} O_i = \{ & b_7\text{: } \textit{domestic-property} \Rightarrow \textit{domestic-company}, \\ & r_3\text{: } \textit{domestic-company} \Rightarrow \neg\, \textit{change} \\ & f_7\text{: } \textit{domestic-property}\} \end{aligned}$$

Which precedent is more on point? If, as in HYPO, we compare all input facts in each cited precedent with the *CFS*, neither of the two precedents is more on point than the other: precedent A shares with the *CFS* factors f_7 and f_{10}, while precedent B shares f_2 and f_7. However, this is a global comparison, not depending on the decision for which a precedent is cited; what is also possible is comparing the precedents relative to their single (sub) decisions.

Let us make such a 'local' comparison of the precedents, and consider the intermediate issue *domestic-company*. The aim of this comparison is to establish a priority relation between b_7 and b_{10}. As remarked above, we must identify the facts that were considered by the court when it decided this issue. One possible answer to this question is that these are the antecedents of the rules that have this issue in their consequent. Now in precedent A these are the rules r_7 and $r_{10/12}$. The antecedents of these rules contain f_7, f_{10} and f_{12}, of which f_7 and f_{10} still hold in the *CFS*. Checking the same for precedent B, we see that its only rule about *domestic-company* is $r_{7/9}$, of which the antecedent contains f_7 and f_9. Of these two facts, only f_7 still holds in the *CFS*. The result is that in this approach A is, with respect to the issue *domestic-company*, more on point than B, for which reason b_{10} has priority over b_7.

In conclusion, restricting the similarity comparison to a portion of a precedent can change the similarity assessment. In our example this is since the fact $\neg$ *kept-house*, which in a global comparison prevents A from being more on point than B, is in B not considered for the intermediate issue *domestic-company* but for the final conclusion *change*.

Let us now turn to the problems in formalizing this analysis. One problem arises when on-pointness is determined with respect to a 'later' conclusion in a precedent, for instance, with respect to A's conclusion *change*. Suppose A is compared with the following conflicting precedent.

$$\begin{aligned} C = \{ & r_{1/18}\text{: } \textit{kept-house} \wedge \textit{kept-old-car-numberplate} \Rightarrow \neg\, \textit{change}, \\ & r_6\text{: } \textit{long-duration} \Rightarrow \textit{change} \\ & p_1\text{: } \Rightarrow r_6 \prec r_{1/18}, \\ & f_2\text{: } \textit{kept-house}, \; f_{18}\text{: } \textit{kept-old-car-numberplate}, \\ & f_6\text{: } \textit{long-duration}\} \end{aligned}$$

As for A, we must now look at the antecedents of r_1 and $r_{4/6}$, which are $\neg$ *domestic-company*, *kept-house* and *long-duration*. The point is that one of these literals, viz. $\neg$ *domestic-company*, was derived in A from another rule, $r_{10/12}$, so we cannot make a simple comparison between the facts of the case and the *CFS*. Instead, we must check which of the literals can still be *derived in the new situation*.

Now the problem is to make the terms 'derived' and 'new situation' precise. As for 'derived', does it mean that the literal must be the conclusion of just an argument or of a justified argument? And as for the 'new situation', does it include, besides the *CFS*, only the rules of the cited precedent or also the rules introduced at a certain state of a dispute? We are inclined to answer both questions in the second way, but the formalization is tricky.

Apart from this, there is another problem. It seems that even with respect to later steps in a precedent it is sometimes better to look at the facts of the precedents (as in HYPO and CATO) than at the antecedents of the rules about the later issue (as we did above). Consider in addition to C the following precedent and current fact situation.

$$\begin{aligned} D = \quad & \{r_{4/6}\text{: } \neg \textit{ domestic-company} \wedge \textit{long-duration} \Rightarrow \textit{change} \\ & f_4\text{: } \neg \textit{ domestic-company}, \ f_6\text{: } \textit{long-duration}\} \end{aligned}$$

$$CFS\text{: } \quad \{f_6 : \textit{long-duration}, \ f_2 : \textit{kept-house}\}$$

Since both C and D are one-steps precedents, our and HYPO's method give the same outcome that C is more on point than D. However, assume that in another case with the same facts as C, the judge has taken the same decision but has made the underlying theory implicit:

$$\begin{aligned} E = \quad & \{r'_{1/18}\text{: } \textit{kept-house} \wedge \textit{kept-old-car-numberplate} \Rightarrow \\ & \textit{showed-intention-to-return} \\ & r_{19}\text{: } \textit{showed-intention-to-return} \Rightarrow \neg \textit{ change}, \\ & r_2\text{: } \textit{long-duration} \Rightarrow \textit{change} \\ & p_2\text{: } \Rightarrow r_2 \prec r_{19}, \\ & f_2\text{: } \textit{kept-house}, \ f_{18}\text{: } \textit{kept-old-car-numberplate}, \\ & f_6\text{: } \textit{long-duration}\} \end{aligned}$$

Then in the same *CFS* our method gives a different answer than HYPO, viz. that E is not more on point than D. However, this seems less than obvious, since C and E have precisely the same facts and the same outcome, and the *CFS* is also the same; the only difference is that in

the second case the judge has made the theory underlying his decision explicit.

In conclusion, it seems that the question how to determine similarity between cases cannot be answered with one single method. It might even be concluded that there is room for disagreement as to how similarity should be measured.[1] Therefore, we assume in the rest of this article that the method for determining on-pointness is chosen by the parties in a debate, and that the result is expressed in the form of defeasible rules. Thus the similarity assessments become debatable.

Below we assume that the parties' on-pointness assessments are expressed in the form

$$\Rightarrow (\neg)\ \textit{More-on-point}(Prec_1, r_1, Prec_2, r_2)$$

which reads as 'with respect to the issue dealt with by r_1 of $Prec_1$ and r_2 of $Prec_2$, the first precedent is (not) more on point than the latter.' Note that this reading makes the on-pointness relation relative to an issue treated by the precedents, instead of to the precedents as a whole.

In the present context we assume that such on-pointness statements are contained in *CSRules*. Since they are defeasible, they are open to attack, which captures that the similarity criteria are debatable.

As remarked above, the idea is that similarity assessments induce a priority relation between the rules that they mention (here $r_2 \prec r_1$). This can be formalized by adding the following rule to *CSRules*.

$$\textit{mop}\colon\quad \textit{More-on-point}(Prec_1, r_1, Prec_2, r_2) \Rightarrow r_2 \prec r_1$$

Note that this rule is also defeasible, so that, even if the parties agree on the similarity criteria, the more-on-point priorities can still be defeated by other priority considerations.

6.2. Distinguishing Portions of Precedents

The example in the previous subsection can be used to explain a subtlety with respect to distinguishing. Argument P_i, which cites precedent A, uses two broadened rules, so it is distinguishable in two ways. The choice how to distinguish is determined by which conclusion of P_i one wants to attack. If one wants to attack the intermediate conclusion *domestic-company*, precedent A can be (weakly) distinguished with respect to factor f_{12}: $\neg$ *domestic-president*, with a rule $\sim \neg$ *domestic-president* $\Rightarrow \neg \textit{appl}(b_{10})$. If instead one wants to attack the final conclusion *change*, precedent A must be distinguished with respect to the

[1] This idea also seems to underlie CATO's 'downplaying a distinction' move.

intermediate conclusion $\neg$ *domestic-company*, with a rule $\sim \neg$ *domestic-company* $\Rightarrow \neg appl(b_4)$.

6.3. Interacting Factors

HYPO embodies an independence assumption with respect to factors in the sense that adding factors pro and deleting factors con a decision always makes an argument for the decision stronger. However, in general this assumption is not warranted. Firstly, it is not always the case that the combination of several factors with the same tendency also has that tendency. To reuse an example of (Prakken & Sartor, 1996b), even if rain and heat are individually reasons not to go jogging, then the combination of these two factors might very well be instead a reason to go jogging. Moreover, even if the combination of two factors does preserve their tendency, it might do so with weaker force. In our example, even if the combination of rain and heat is still a reason not to go jogging, it might be a weaker reason than just rain or just heat, because the combination is less unpleasant.

The argument-based system that underlies our model respects these observations. Firstly, factors pro do not automatically combine into a new factor pro: two rules $f_1 \Rightarrow d$ and $f_2 \Rightarrow d$ do not logically imply a third rule $f_1 \wedge f_2 \Rightarrow d$; if $f_1 \wedge f_2$ is also a reason for d, the third rule must be added by hand to the premises. Moreover, even if this is added, its priority relations do not logically depend on those for the individual rules. Thus, the logic of our system does not compel us to recognise that by joining all reasons for a conclusion we always obtain a stronger argument.

However, in those contexts when this is considered appropriate, this result can be obtained 'by default', viz. by adding the following scheme of general rules to *CSRules*. In this scheme r^+ denotes any rule obtained from r by adding zero or more literals to r's antecedent — note that by convention these literals are also factors pro the conclusion — and r^- denotes any broadening of r.

$$r\text{:} \quad r_1 \prec r_2 \Rightarrow r_1^- \prec r_2^+$$

Note that this rule scheme is defeasible, so that it can be defeated when appropriate.

6.4. An Example

We now give an example illustrating our theory, with a background information theory based on our tax example.

THE BACKGROUND INFORMATION

We assume that the BI contains the following factors, which are added to *CSRules* as rules *factor* $\Rightarrow$ *supported conclusion*.

Factor:	*supported conclusion:*
f_1: *kept-house*	$\neg$ *change*
f_2: $\neg$ *kept-house*	*change*
f_3: *domestic-company*	$\neg$ *change*
f_4: $\neg$ *domestic-company*	*change*
f_5: *short-duration*	$\neg$ *change*
f_6: *long-duration*	*change*
f_7: *domestic-property*	*domestic-company*
f_8: $\neg$ *domestic-property*	$\neg$ *domestic-company*
f_9: *domestic-headquarters*	*domestic-company*
f_{10}: $\neg$ *domestic-headquarters*	$\neg$ *domestic-company*
f_{11}: *domestic-president*	*domestic-company*
f_{12}: $\neg$ *domestic-president*	$\neg$ *domestic-company*
f_{13}: $\neg$ *domestic-job-prospects*	*change*
f_{14}: *domestic-citizenship*	$\neg$ *change*
f_{15}: $\neg$ *domestic-citizenship*	*change*

We also assume that *CSRules* contains the *mop* rule of Section 6.1. the relevant unconditional on-pointness rules, and the r rule of Section 6.3.

THE CASE BASE

The precedential knowledge base *Cases* consists of three cases. As for notation, the r and p rules are in *CaseRules* and the f rules are in *CaseFacts*.

The first precedent is for $\neg$*change*.

$A =$ $\{r_7$: *domestic-property* $\Rightarrow$ *domestic-company*,
$r_{10/12}$: $\neg$ *domestic-headquarters* $\wedge$ $\neg$ *domestic president* $\Rightarrow$
$\neg$ *domestic company*,
$r_{3/5/14}$: *domestic-company* $\wedge$ *short-duration* $\wedge$
domestic-citizenship $\Rightarrow$ $\neg$ *change*,
$r_{2/13}$: $\neg$ *kept-house* $\wedge$ $\neg$ *domestic-job-prospects* $\Rightarrow$ *change*,
p_1: $\Rightarrow r_{2/13} \prec r_{3/5/14}$,
p_2: $\Rightarrow r_{10/12} \prec r_7$,
f_2: $\neg$ *kept-house*, f_7: *domestic-property*, f_5: *short-duration*,
f_{10}: $\neg$ *domestic headquarters*, f_{12}: $\neg$ *domestic president*,
f_{13}: $\neg$ *domestic-job-prospects*, f_{14}: *domestic-citizenship*$\}$

This precedent includes a justified argument for $\neg$*change*, viz. $[f_5, f_7, f_{14}, r_7, r_{3/5/14}]$.

The second precedent is for *change*.

$B =$ $\{r_2$: $\neg$ *kept-house* $\Rightarrow$ *change*,
r_5: *short-duration* $\Rightarrow$ $\neg$ *change*,
p_3: $\Rightarrow r_5 \prec r_2$,
f_2: $\neg$ *kept-house*, f_5: *short-duration*$\}$

This precedent contains a justified argument for *change*, viz. $[f_2, r_2]$.

The third precedent concerns a company tax case, and includes a justified argument for $\neg$ *domestic-company*.

$C =$ $\{r_{10}$: $\neg$ *domestic-headquarters* $\Rightarrow$ $\neg$ *domestic-company*,
$r_{7/11}$: *domestic-property* $\wedge$ *domestic-president* $\Rightarrow$
domestic-company,
r'_4: $\neg$ *domestic-company* $\Rightarrow$ $\neg$ *taxable-company*,
p_4: $\Rightarrow r_{7/11} \prec r_{10}$,
f_7: *domestic-property*, f_{10}: $\neg$ *domestic-headquarters*,
f_{11}: *domestic-president*$\}$

Finally, the current fact situation is

CFS $=$ $\{f_2$: $\neg$ *kept-house*, f_7: *domestic-property*,
f_5: *short-duration*, f_{10}: $\neg$ *domestic-headquarters*,
f_{13}: $\neg$ *domestic-job-prospects*,
f_{14}: $\neg$ *domestic-citizenship*$\}$

A Dispute

We now discuss an example dispute based on the just-given case base and *CFS*. The outcome of the dispute is evaluated according to the second definition of Γ given in Section 5.4, i.e. relative to the actually introduced premises. The dispute is graphically displayed in Figure 3.

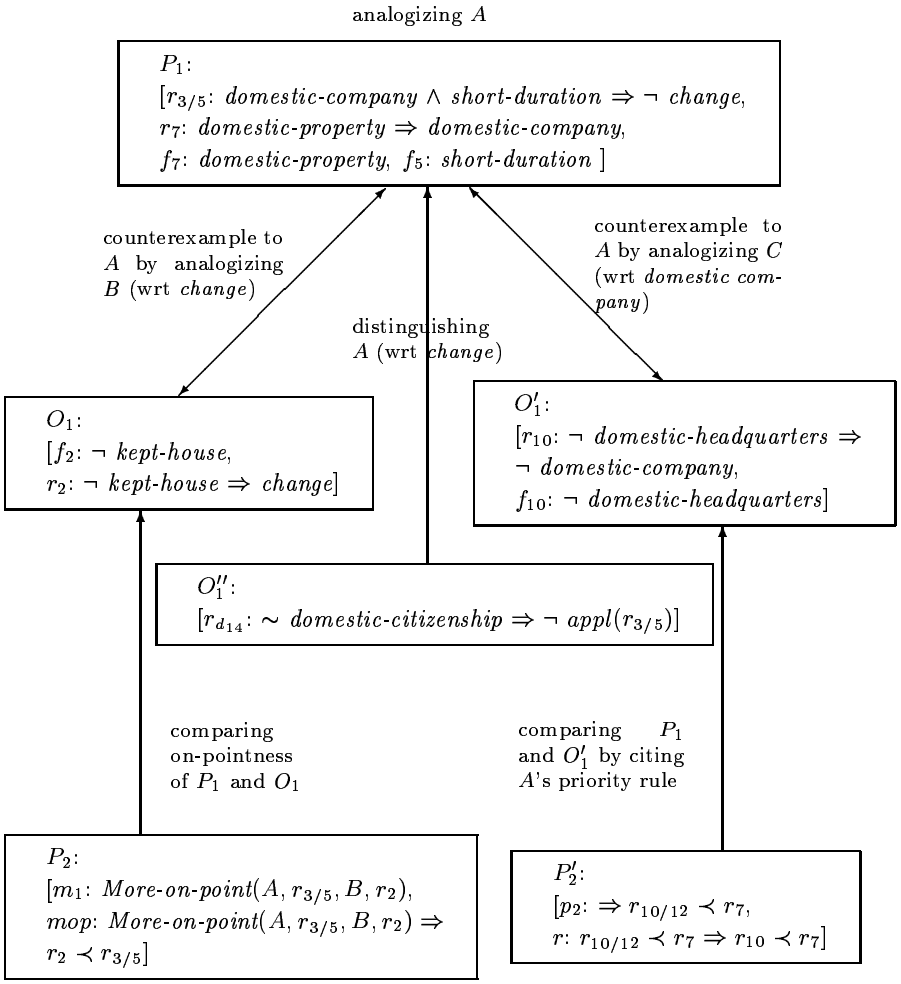

Figure 3. A dispute (won by O)

The dispute starts with the ordered theory $\Gamma_0 = CFS \cup Rules\text{-}of\text{-}Cases \cup CSRules$. The proponent (the tax office) wants to defend ¬

change and starts the dispute by referring to A. In particular, the tax office wants to use the rule

$$r_{3/5/14}\text{: } \textit{domestic-company} \wedge \textit{short-duration} \wedge \textit{domestic-citizenship} \Rightarrow \neg\ \textit{change}$$

However, this rule cannot be directly cited, since the condition *domestic-citizenship* is not satisfied in the CFS. An analogy is required, through which the broadening:

$$r_{3/5}\text{: } \textit{domestic-company} \wedge \textit{short-duration} \Rightarrow \neg\ \textit{change}$$

is inputted into the dispute (using Definition 5.3). Furthermore, P must also use rule r_7 of A, which provides the intermediate conclusion *domestic-company*. The whole argument is

$$P_1\text{: } [r_{3/5}\text{: } \textit{domestic-company} \wedge \textit{short-duration} \Rightarrow \neg\ \textit{change},\ r_7\text{: } \textit{domestic-property} \Rightarrow \textit{domestic-company},\ f_7\text{: } \textit{domestic-property},\ f_5\text{: } \textit{short-duration}\ ]$$

At this point the ordered theory is $\Gamma_1 = \Gamma_0 \cup \{r_{3/5}\}$.

In order to build an actual dialogue tree according to Definition 5.6, the opponent must now by clause (4) of Definition 4.1 state an argument that defeats P_1. One way in which O can do so is by giving a counterexample to the precedent A used by P_1, by referring to precedent B (this move was in Section 2 called 'restrictive distinguishing'). No broadening is required since B contains a rule which directly applies in the *CFS*.

$$O_1\text{: } [f_2\text{: } \neg\ \textit{kept-house},\ r_2\text{: } \neg\ \textit{kept-house} \Rightarrow \textit{change}]$$

According to our framework, O_1 defeats P_1, since its rule r_2 head-to-head conflicts with P_1's rule $r_{3/5}$ (recall that for assessing the force of O's moves no priorities are needed).

As for the ordered theory, we now have $\Gamma_2 = \Gamma_1$, and the actual dialogue tree constructed at this stage is $T_2 = P_1 - O_1$. Although this tree ends with a move by O, P can reply without introducing a new rule, so Definition 5.7 tells us that at this point there is no winner. In particular, P can reply by stating a more-on-point assessment (which we assume to be in *CSRules*) and by using the *mop* rule (which is also in *CSRules*).

$$P_2\text{: } [m_1\text{: } \textit{More-on-point}(A, r_{3/5}, B, r_2),\ \textit{mop}\text{: } \textit{More-on-point}(A, r_{3/5}, B, r_2) \Rightarrow r_2 \prec r_{3/5}]$$

P_2 is an application of Clause (3b) of Definition 4.1: it is a priority argument that makes P_1 strictly defeat O_1.

P's on-pointness assessment follows the local comparison method explained above at the beginning of Subsection 6.1. According to this method, the court in A has, when deciding $\neg$ *change*, considered the antecedents of $r_{3/5/14}$ and $r_{2/13}$, which are $\neg$ *kept-house*, *short-duration*, $\neg$ *domestic-job-prospects*, *domestic-company* and *domestic-citizenship*. Of these literals, the first three are as facts in the *CFS*, while *domestic-company* can be derived from r_7 with f_7, which is also in the *CFS*. Only *domestic-citizenship* does not hold in the new situation, so the 'overlap' of A with the new situation is

$\{\neg$ *kept-house*, *short-duration*, $\neg$ *domestic-job-prospects*, *domestic-company*$\}$

Applying the same method to B means that when deciding *change*, the court has considered the antecedents of r_2 and r_5, which are $\neg$ *kept-house* and *short-duration*. Both of these literals are in the *CFS*, so the overlap of B with the new situation is

$\{\neg$ *kept-house*, *short-duration*$\}$

Clearly, this set is a strict subset of the overlap of A with the new situation, so with respect to *change* A is more on point than B.

Note that in HYPO the fact that O_1 is less on point than P_1 makes that O_1 is not an allowed reply to P_1. The reason why we instead allow this move is that perhaps O can attack P with a conflicting priority argument, based on grounds other than similarity (although in our example O cannot construct such an argument).

We now have that $\Gamma_3 = \Gamma_2$, and the actual dialogue tree at this point is $T_2 = P_1 - O_1 - P_2$. Although its only branch ends with a move by P, P is not winning, since O can extend the tree without introducing a new rule: O can create a new branch of the tree by citing a portion of case C, which contains an argument that attacks a subargument of P_1.

O_1': [r_{10}: $\neg$ *domestic-headquarters* $\Rightarrow$ $\neg$ *domestic-company*,
f_{10}: $\neg$ *domestic-headquarters*]

We now have that $\Gamma_4 = \Gamma_3$, and the actual dialogue tree at this point has two branches: $T_{3a} = P_1 - O_1 - P_2$, and $T_{3b} = P_1 - O_1'$. Nobody is winning, since the proponent can again extend the tree without introducing a new rule. In particular, P can cite a priority rule from precedent A,

and combine it with the priority scheme r of Section 6.3., which results in a priority argument that makes P_1 strictly defeat O'_1.

$$P'_2\colon \quad [p_2\colon \Rightarrow r_{10/12} \prec r_7,\ r\colon r_{10/12} \prec r_7 \Rightarrow r_{10} \prec r_7]$$

We now have $\Gamma_5 = \Gamma_4$, and an actual dialogue tree with still two branches: $T_{4a} = T_{3a}$, and $T_{4b} = P_1 - O'_1 - P'_2$.

O cannot attack this priority conclusion, and O cannot extend the tree without introducing a new rule, so at this stage P is winning, since all branches of the tree end with moves by P: so the tree is a proof that on the basis of Γ_5 the argument P_1 for $\neg$ *change* is justified.

However, O can reverse the outcome by introducing a distinction: O can distinguish P_1 with the following argument.

$$O''_1\colon \quad [r_{d_{14}}\colon \sim \neg\ \textit{domestic-citizenship} \Rightarrow \neg\ \textit{appl}(r_{3/5})]$$

Note that $r_{d_{14}}$ has been introduced by applying Definition 5.4. At this point we have $\Gamma_6 = \Gamma_5 \cup \{r_{d_{14}}\}$, and the actual dialogue tree now has three branches: $T_{5a} = T_{4a}$, $T_{5b} = T_{4b}$, and $T_{5c} = P_1 - O''_1$. One of these branches ends with a move by O and P cannot extend the branch without introducing a new rule, so at this stage O is winning: the tree is a proof that on the basis of Γ_6 the argument P_1 for $\neg$ *change* is not justified. Moreover, since P cannot even reply with introducing new rules, P cannot reverse this result. At first sight, this would seem to be too strong, but here it should be recalled that our model is not intended to exhaust the heuristics for introducing premises.

7. Summary of the Results Obtained

Let us now go back to the case-based systems discussed in Section 3, compare these systems with our approach and discuss how the features of these systems that we wanted to model are captured in our framework. We must state beforehand a caveat. We have presented an abstract, logical framework and we have tried to relate it to some features of existing systems (HYPO, CABARET, Branting's work, and CATO): thus we have on the one hand provided an analysis of these features in a more general and abstract theoretical framework than these systems, but on the other hand we have ignored many of their interesting knowledge-representation and implementation aspects, which would have to be addressed again in an implementation of our framework. Nevertheless, our abstract theory may be useful not only to gain more

insight into case-based reasoning, but also to compare different systems and to suggest ways of integrating and developing them.

HYPO

To start with, as mentioned in the introduction, we differ from HYPO in adopting a 'normative' dialectical approach, where the aim is to test the tenability of a claim, while HYPO has a more cognitive approach, focused more on the generation and less on the evaluation of debates. This is reflected in two more specific differences. Firstly, while our dialogue game has dialectical asymmetry between the parties, in HYPO the rules are on this point the same for the proponent and the opponent: in particular, while in our dialogue game the proponent's moves must have stronger force than the opponent's previous move, in HYPO a plaintiff's move is also allowed if it is not weaker than the defendant's previous move. Secondly, while in our system the rule priorities are used for adjudicating between conflicting arguments, in HYPO the more-on-point ordering is used for selecting the best move for a player and not for determining the outcome of a dispute (with one exception).

Another general difference is that while we have a formal theory, defining the space of possible dialogues, HYPO is an implemented program that is meant to actually traverse such a space, i.e., its task is to generate disputes. However, it is not difficult to imagine how our protocol, or a modified version, could also be used to generate dialogues, by adding the appropriate control rules.

With this in mind, we can observe the following differences and similarites between our approach and HYPO.

HYPO's case representation scheme can be captured in our framework as a limit case, by assuming that each case contains, besides the facts, just two rules and one priority statement. For example, we can represent a case won by plaintiff, who argued for d, and with pro-plaintiff factors $f_1^\pi \wedge \ldots \wedge f_n^\pi$ and pro-defendant factors $f_1^\delta \wedge \ldots \wedge f_m^\delta$, as follows.

r_π: $\quad f_1^\pi \wedge \ldots \wedge f_n^\pi \Rightarrow d$
r_δ: $\quad f_1^\delta \wedge \ldots \wedge f_m^\delta \Rightarrow \neg d$
p: $\quad \Rightarrow r_\delta \prec r_\pi$

HYPO's dialectical moves are then captured by our notions of following, analogizing and distinguishing precedents. In particular, if a case rule is analogized by broadening a rule, then our distinction as defined in Definition 5.4 points to the case factors that are missing in the *CFS*, exactly as HYPO's distinguishing does. Note also that in our system, as

in HYPO, a party can only distinguish a precedent if the missing factor favours the other party. Note finally, that HYPO's notion of a counterexample, i.e., attacking an analogy by citing a case with the missing factor and the opposite outcome, is captured in our model by the possibility of simply using such a case in a counterargument. In Section 6.4. this was illustrated with the opponent's move O_1. There is one difference, however: unlike in our system, in HYPO a counterexample must be more on point than the attacked case. This is a point illustrating the difference between 'normative' and 'cognitive' dialectics.

There are more differences. Firstly, HYPO models reasoning with hypothetical precedents, and it allows for non-boolean factors. It seems to us, however, that there are no theoretical objections to extending our analysis with these features. We have also extended the HYPO approach in a number of respects. As illustrated above, our system allows for the representation of multi-steps precedents and correspondingly for the citation of portions of precedents. Furthermore, our system allows, unlike HYPO's 3-ply disputes, for dialogues of arbitrary depth, and our system allows substantive debates on the criteria for comparing precedents. To expand on the latter, although above we indicated how HYPO's more-on-point ordering on precedents can be incorporated in our system, we have also argued that this ordering is only one possible view on the relation between two precedents. More precisely, if for some other reason a party regards a less-on-point case as superior to a more-on-point case, then in our system that party can express this view by stating a conflicting priority argument. For instance, if the proponent says that its precedent is more on point, the opponent could counter by saying that its precedent is more recent. Then the debate could continue on whether on-pointness or recency is the more important standard. This is why in Section 6.4. we allowed O_1 to state a counterargument, although it was less on point than the analogy it attacked. Finally, the expressiveness of our rule language, which allows for rules about rules, opens prospects for representing teleological arguments, by which we mean arguments referring to the purposes of rules (see also Hage, 1996, 1997). However, we leave applications of this possibility to future research. The downside of the increase in expressivity is, of course, a decrease in computational efficiency.

Branting

Let us now move to Branting's work. As we intended, we model Branting's stepwise reduction-graph model of ratio decidendi simply by representing a case as a multi-step argument. Correspondingly, we have preserved Banting's idea of citing portions or precedents. A point that

is not addressed by Branting is the possibility of multiple rationes decidendi in a case (recognized by e.g. Cross & Harris (1991, p. 81)). In our approach this can be captured by including in the case multiple arguments for its decision.

Branting (1994) lists five evaluation criteria for models of ratio decidendi. In Section 2 we have provided a (partial) model of the content of precedents, which we have formalized in the rest of this article. We have also observed that the notion of a ratio decidendi may the linked to that of (the rules in) a justified argument. We do not want to go into the question whether our and Branting's model precisely capture the notion of ratio decidendi as discussed in legal theory. Nevertheless, it is interesting to evaluate our model in the light of Branting's criteria. We claim that our model of Section 2 directly satisfies some of these criteria and can be easily made to satisfy the other criteria.

Firstly, the criterion that the ratio decidendi captures the propositions necessary to the decision can be satisfied by making sure that arguments do not contain irrelevant rules. Note, however, that we would say that a precedent containing multiple justified arguments has multiple rationes decidendi, so that in our framework the necessity criterion only applies within each ratio, not to the overall decision. Secondly, our model obviously shares Branting's observation that a precedent often contains several abstraction steps from the facts to the decision, since it allows for multistep arguments. Thirdly, in our model the rationale of a decision can be grounded in the specific facts of the case by including the appropriate facts in the justified arguments. Fourth, our account allows a precedent to contain the theory underlying the decision, in the form of an argument with the appropriate rules. And, finally, we share Branting's observation that the rationale of a decision can be limited, extended or overturned by subsequent decisions, since in our framework a justified argument of a case can be attacked, analogized and even defeated with arguments based on subsequent precedents.

CABARET

As far as CABARET's notions of broadening and discrediting a rule are concerned, we think that our notions of analogizing and distinguishing come close to capturing those notions. Firstly, we allow the broadening of not just precedent rules but also rules in *CSRules*, which might contain statutory rules. And CABARET's way of broadening a rule by citing a case where a rule was applied although not all of its preconditions were satisfied, can be approximated in our model by citing a case that contains the broadened rule. Furthermore, our system naturally allows the use of precedents to develop arguments concerning the

antecedents of rules. And CABARET's heuristic for discrediting a rule has its exact counterpart in our model: an argument using the rule can be attacked by an argument citing a case with the opposite outcome.

However, we have not addressed many other interesting features of CABARET. As mentioned above, it would be interesting to investigate how the argument strategies, moves and primitives of Skalak & Rissland (1992) could be integrated with our model of actual dialogues.

CATO

With respect to CATO, as far as it incorporates elements of HYPO, our above remarks on HYPO also apply to CATO. As for CATO's new features that we wanted to include, our first aim was to be able to express a factor hierarchy. This is indeed possible, by expressing it as a set of *CSRules* and by expressing priorities between these rules. We also wanted to be able to express multiple views on the relation between factors. This is possible since our system allows *CSRules* to be inconsistent and does not assume any other property of this set.

We now come to two of the new argument moves that in CATO are made possible by the factor hierarchy, emphasizing and downplaying a distinction. We believe that some aspects underlying these moves are present in our system or can be added to it. Let us go back to our example in Section 3.4., and represent it as follows.

$$D\text{: } \{r_{1/5}\text{: } \textit{kept-house} \wedge \textit{short-duration} \Rightarrow \neg\ \textit{change},\ f_1\text{: } \textit{kept-house},\ f_5\text{: } \textit{short-duration}\}$$

As we remarked above, downplaying a distinction comes down to saying that while there is a distinction at the factual level, at a more abstract level a parallel can be drawn. Consider the following current fact situation.

$$CFS = \{f_5 : \textit{short-duration},\ f_{18}\text{: } \textit{kept-old-car-number-plate}\}$$

And assume that a proponent of $\neg$ *change* starts a dialogue with analogizing precedent D, by broadening $r_{1/5}$.

$$P_1\text{: } [r_5\text{: } \textit{short-duration} \Rightarrow \neg\ \textit{change},\ f_5 : \textit{short-duration}]$$

The opponent replies by distinguishing r_5.

$$O_1\text{: } [r_{d5}\text{: } \sim \textit{kept-house} \Rightarrow \neg\ \textit{appl}(r_5)]$$

We now make some assumptions about the content of *CSRules*. Suppose it contains the following rules, formalizing a part of a factor hierarchy displayed in Figure 4.

fh_1: *kept-house* $\Rightarrow$ *showed-intention-to-return*
fh_2: *kept-old-car-numberplate* $\Rightarrow$ *showed-intention-to-return*

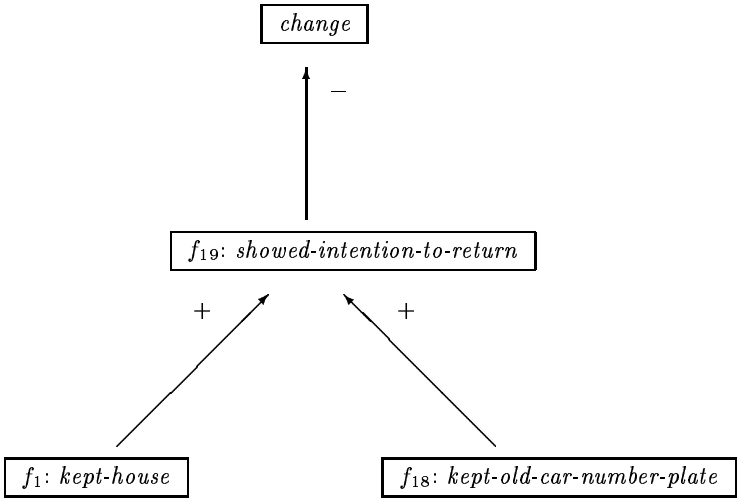

Figure 4. A partial factor hierarchy

We could now define a new premise introduction heuristic for P: we could allow him to use instead of the rule $r_{1/5}$ a new, more abstract rule

$r_{5/19}$: *showed-intention-to-return* $\wedge$ *short-duration* $\wedge \Rightarrow \neg$ *change*

and use this rule in a 'backtracking' response to O_1, with

P_1': [$r_{5/19}$: *showed-intention-to-return* $\wedge$ *short-duration*
$\Rightarrow \neg$ *change*,
fh_2: *kept-old-car-numberplate* $\Rightarrow$ *showed-intention-to-return*,
f_5: *short-duration*, f_{18}: *kept-old-car-number-plate*]

Thus O's distinction is downplayed by P by 'backtracking' in the dispute, starting a new actual dialogue tree, with an improved argument for $\neg$ *change*.[11] This account of abstraction type hierarchy follows the

informal analysis that was given in (Prakken, 1993), pp. 21–2 and (Prakken, 1997), pp. 27–8.

Let us now turn to emphasizing a distinction. Consider the following current fact situation.

$$CFS' = \{f_5\text{: } \textit{short-duration}\}$$

As explained in Section 3.4., CATO not only allows (as HYPO) to distinguish D by saying that the CFS lacks D's factor *kept-house*, but it also allows to emphasize this distinction by saying that thus in the CFS it does not hold that *showed-intention-to-return*, unlike in D. Thus CATO allows explaining the difference in terms of the factor hierarchy. How could this be modelled in an extension of our protocol? This could be done by allowing O_1 to distinguish P_1 with the following argument.

$$\begin{aligned} O_1'\text{: } & [r'_{d5}\text{: } \sim \textit{kept-house} \Rightarrow \neg\ \textit{showed-intention-to-return}, \\ & r_{d19}\text{: } \neg\ \textit{showed-intention-to-return} \Rightarrow \neg\ \textit{appl}(r_5)] \end{aligned}$$

We leave the precise definition of this move, and of abstraction type analogy, to future research. Nevertheless, we hope to have shown that our system provides a suitable basis for defining case-based reasoning moves as heuristics for introducing premises into a dispute. In the present paper we have focused on two such heuristics, viz. HYPO-style analogizing and distinguishing, but as systems like CABARET and CATO show, many more remain to be studied.

8. Related Research on Formal Models of Argumentation

In the course of the paper we have frequently cited previous work on case-based reasoning. However our model also builds upon previous logic-based accounts of legal case-based reasoning. To our knowledge the first analysis of this kind was (Loui et al., 1993), further developed in (Loui & Norman, 1995). In the latter paper the use of rationales in legal argument is studied in a dialectical setting. A protocol for dispute is formally defined, and various uses of rationales within the protocol are analysed. As we understand Loui & Norman, these uses are modelled as ways to modify the representation of a case. Our idea to represent cases as a collection of possibly conflicting arguments was inspired by Loui & Norman, who use the method in formalizing a certain type of rationale of precedents, a so-called 'disputation rationale'. Their idea is that a party who wants to attack the use of a certain precedent,

can do so by first arguing that the ratio decidendi of the precedent was in fact the result of a choice between conflicting arguments, by then replacing the rule of the case by these conflicting arguments, and by finally showing that in the new fact situation the outcome of the dispute would have been different.

Further exploiting their 1995 case representation method, Loui & Norman (1997) analyse various ways of making and attacking analogical uses of cases. One of them is abstraction type analogy, discussed in this paper in Sections 2.2.1 and 7. They do not embed their analysis in a formal protocol for dispute. It would be interesting to see how their analysis can be embedded in our system as premise introduction heuristics.

Hage (1996) gives, in the context of his 'reason-based logic' a representation method for cases that is similar to ours in that it separates the reasons pro and con and expresses the resolution of their conflict as a priority rule. However, his method is not embedded in a dialectical context.

Vreeswijk (1996) has earlier embedded HYPO-style reasoning in a formally defined dialectical protocol, but since this is not the main theme of his paper (which is reasoning about protocol), his analysis is simpler and less detailed than ours: in particular, he does not generalize HYPO's case representation method, he does not formalize reasoning about priorities and he does not discuss ways of distinguishing precedents.

Finally, we briefly compare our model with Gordon's (1995) Pleadings Game, which formalizes and implements civil pleading as a dialogue game, thus addressing the third, procedural layer of our four-layered (and his three-layered) model of legal argument. Both systems assume a system for defeasible argumentation at the second, dialectical level (Gordon uses the proof theory of Geffner & Pearl's (1992) system for conditional entailment). Furthermore, both systems allow the introduction of premises during a dialogue. However, while Gordon's model allows the introduction of any piece of information as long as it is relevant to the discussion, in our model the only way to introduce new premises is by analogical reasoning. On the other hand, the Pleadings Game does not account for analogical reasoning with legal precedents. These differences result from the fact that while Gordon focuses on the *speech act* aspects of argumentation, i.e., on the procedural layer, we focus on its *heuristic* aspects, i.e., on the heuristic, or strategic layer. As we argued several times above, we believe that a full account of legal argument should combine these two layers.

9. Conclusion

Summarizing, we can ask what has been gained by our logical analysis of case-based legal reasoning. We think we have gained a number of things. Firstly, we have shown that several features of some systems developed for case-based reasoning in the legal domain may also be viewed as special cases of a more general theory of defeasible argumentation, which (we hope) has illuminated and clarified these features. This in turn has made it possible to suggest some possible extensions and refinements of these systems. We also hope that our work may facilitate the application of HYPO-style reasoning in domains similar to the law; without embedding the HYPO approach in an abstract theory similarities between different domains might remain hidden. On the other hand, our logic-based approach has abstracted from many implementation issues, for which reason it is not readily implementable.

It might be asked whether we have shown that our model is a correct model of legal reasoning. We have not undertaken an empirical comparison of our system with actual reasoning of lawyers (as done in Aleven & Ashley, 1997). The reason is that our theory is, as explained in the introduction, a normative theory: it does not aim to capture how lawyers actually argue, but to express how they should argue. Comparing our theory with actual arguments produced by 'good' lawyers would of course be useful, since it is reasonable to assume that many recognized legal experts reason rationally. However, such a comparison would not provide an adequate validation test for our theory, since then the question would shift to whether this assumption is indeed warranted. In fact, the problem is the same as with validating logical systems. In the philosophy of logic this is a difficult issue, to which no clear-cut answer exists. In the present paper we have addressed it by basing our analysis on legal-philosophical reflections, presented in Section 2.

Finally, it should be noted that our system is just beginning to address the heuristic aspects of dialectical legal argument. At various places we have suggested additional heuristics for premise introduction, and we have remarked that other aspects of HYPO, CATO, CABARET and Branting's work might also be included in our model, but we have left this for future research. We hope that the formal theory of this paper, and its embedding in a four-layered picture of legal argument, provides a good basis for carrying out this research. More generally, we hope that this paper will promote future co-operation between two different sections of the AI & law community, both interested in dialectical legal argument.

Acknowledgements

The authors are grateful to Vincent Aleven, Kevin Ashley, Karl Branting and Stephanie Brüninghaus for their useful and stimulating comments on earlier versions of this paper.

Notes

[1] The first three layers were earlier distinguished by Prakken (1995) and Gordon & Karacapilidis (1997), while a somewhat different three-layered model was proposed by Brewka & Gordon (1994).

[2] In our opinion, the third and fourth layer address what McCarty (1997) calls the theory formation aspect of legal argument.

[3] By a rule we mean any general warrant (or inference policy) according to which a certain factor defeasibly supports a certain conclusion. More specific notions of rules, such as those assumed when (rigid) rules are opposed to principles (Dworkin, 1977), or when (exclusionary) rules are opposed to first order reasons (Raz, 1975) are not considered in our framework.

[4] Earlier discussed in Prakken (1993), pp. 22–3. Another example is discussed by Branting & Porter (1991), as an instance of what they call "case elaboration".

[5] For simplicity we assume in this paper, unlike HYPO, that all factors are two-valued, i.e., either true or false.

[6] Although HYPO allows rules for determining the presence of a factor on the basis of factual input, these rules cannot be used (or attacked) for dialectical purposes.

[7] For notational convenience we shall often list a fact of a case as a literal preceded by a name f_i. Formally, a fact p_i with name f_i is a strict rule f_i: $\rightarrow p_i$.

[8] To formalize this, we must also define a naming convention for rules, in order to encode which rule broadens which. As for the rule names of the case rules, we assume that these consist of function expressions of the form

$$name(t, t_1, \ldots, t_n)$$

where the function symbol *name* is as usual the informal name of the rule, and where the terms $t_1, \ldots, t_n$ are as usual the terms occurring in the rule. What t stands for depends on whether the rule is intended to be a broadening of another rule or not. If not, then $t = name$; otherwise t is equal to the name of the rule of which *name* is intended to be a broadening. This condition is needed to deal with situations where a certain rule r contained in one precedent C_1 coincides with a rule in another precedent C_2. If r is directly used as contained in C_1, the first argument of r's name is r, and if r is used as broadening a rule r' in C_2, the first argument of its name is r'. Only in the second case is r distinguishable. Finally, we assume that rules that are the same except differences in their terms have the same informal name. In our examples we leave the convention implicit and only give the function symbol part of the names (e.g. r_1 instead of $r_1(name, x, y)$).

[9] In (Prakken & Sartor, 1997b) we only formalized strong distinguishing.

[10] In the rest of this paper we leave the function arguments of the rule names implicit.

[11] Recall that we abstract from specific control structures for constructing actual dialogue trees during a dispute.

References

Alexy, R. 1989. *A Theory of Legal Argumentation. The Theory of Rational Discourse as Theory of Legal Justification.* Oxford: Clarendon.

Aleven, V. & Ashley, K.D. 1996. How different is different? Arguing about the significance of similarities and differences. In *Advances in Case-Based Reasoning: Proceedings of the Third European Workshop on Case-Based Reasoning*, eds. I. Smith & B. Faltings. Springer Lecture Notes in AI 1168, 1–15. Berlin: Springer Verlag.

Aleven, V. & Ashley, K.D. 1997. Evaluating a learning environment for case-based argumentation skills. In *Proceedings of the Sixth International Conference on Artificial Intelligence and Law*, 170–179. New York: ACM Press.

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

Berman, D.H. & Hafner, C.D. 1991. Incorporating procedural context into a model of case-based legal reasoning. *Proceedings of the Third International Conference on Artificial Intelligence and Law*, 12–20. New York: ACM Press.

Berman, D.H. & Hafner, C.D. 1995. Understanding precedents in a temporal contex of evolving legal doctrine. *Proceedings of the Fifth International Conference on Artificial Intelligence and Law*, 42–51. New York: ACM Press.

Bondarenko, A., Dung, P.M., Kowalski, R.A. & Toni, F. 1997. An abstract, argumentation-theoretic approach to default reasoning. *Artificial Intelligence* 93, 63–101.

Branting, L.K. 1991. Reasoning with portions of precedents. *Proceedings of the Third International Conference on Artificial Intelligence and Law*, 145–154. New York: ACM Press.

Branting, L.K. 1994. A computational model of ratio decidendi. *Artificial Intelligence and Law* 2, 1–31.

Branting, L.K., Porter, B.W. 1991. Rules and precedents as complementary warrants. *Proceedings of the Ninth National Conference on Artificial Intelligence (AAAI-1991).*

Brewka, G. & Gordon, T.F. 1994. How to buy a Porsche, an approach to defeasible decision making. In *Working Notes of the AAAI-94 Workshop on Computational Dialectics*, 28–38. Seattle, Washington.

Cross, R. & Harris, J.W. 1991. *Precedent in English Law*, 4th edition. Oxford: Clarendon Press.

Dung, P.M. 1995. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming, and n–person games. *Artificial Intelligence* 77, 321–357.

Dworkin, R.M. 1977. *Taking Rights Seriously.* London: Duckworth.

Dworkin, R.M. 1985. *A Matter of Principle.* London: Harvard University Press.

Geffner, H. & Pearl, J. 1992. Conditional entailment: bridging two approaches to default reasoning. *Artificial Intelligence* 53, 209–244.

Goldstein, L. (ed.) 1987. *Precedent in Law.* Oxford: Oxford University Press.

Gordon, T.F. 1995. *The Pleadings Game. An Artificial Intelligence Model of Procedural Justice.* Kluwer, 1995.

Gordon, T.F., & Karacapilidis, N. 1997. The Zeno argumentation framework. In *Proceedings of the Sixth International Conference on Artificial Intelligence and Law*, 10–18. New York: ACM Press.

Hage, J.C. 1996. A theory of legal reasoning and a logic to match. In (Prakken & Sartor, 1996c), 43–117.

Hage, J.C. 1997. *Reasoning With Rules. An Essay on Legal Reasoning and Its Underlying Logic.* Dordrecht etc.: Kluwer Law and Philosophy Library.

Hage, J.C., Leenes, R. & Lodder, A.R. 1994. Hard cases: a procedural approach. *Artificial Intelligence and Law* 2: 113–166.

Klug, U. 1966. *Juristische Logik.* Berlin: Springer.
Loui, R.P. 1987. Defeat among arguments: a system of defeasible inference. *Computational Intelligence* 2, 100–106.
Loui, R.P. 1998. Process and policy: resource-bounded non-demonstrative reasoning. To appear in *Computational Intelligence* 14:1.
Loui, R.P., Norman, J., Olson, J. & Merrill, A. 1993. A design for reasoning with policies, precedents, and rationales. *Proceedings of the Fourth International Conference on Artificial Intelligence and Law*, 202–211. New York: ACM Press.
Loui, R.P. & Norman, J. 1995. Rationales and argument moves. *Artificial Intelligence and Law* 3: 159–189.
Loui, R.P. & Norman, J. 1997. Eliding the arguments of cases. Submitted.
MacCormick, N. 1978. *Legal Reasoning and Legal Theory.* Oxford: Clarendon.
MacCormick, N. 1987. Why cases have rationes and what these are. In (Goldstein, 1987), 155–182.
McCarty, L.T. 1995. An implementation of Eisner v. Macomber. *Proceedings of the Fifth International Conference on Artificial Intelligence and Law*, 276–286. New York: ACM Press.
McCarty, L.T. 1997. Some arguments about legal arguments. In *Proceedings of the Sixth International Conference on Artificial Intelligence and Law*, 215–224. New York: ACM Press.
McCarty, L.T. & Sridharan, N.S. 1981. The representation of an evolving system of legal concepts: II. Prototypes and deformations. *Proceedings of the Seventh International Joint Conference on Artificial Intelligence*, 246–253.
Mill, J.S. [1859] 1974. *On Liberty.* Harmondsworth: Penguin.
Pollock, J.L. 1987. Defeasible reasoning. *Cognitive Science* 11, 481–518.
Prakken, H. 1993. *Logical Tools for Modelling Legal Argument.* Doctoral dissertation Free University Amsterdam.
Prakken, H. 1995. From logic to dialectics in legal argument. *Proceedings of the Fifth International Conference on Artificial Intelligence and Law*, 165–174. New York: ACM Press.
Prakken, H. 1997. *Logical Tools for Modelling Legal Argument. A Study of Defeasible Reasoning in Law.* Dordrecht etc.: Kluwer Law and Philosophy Library.
Prakken, H. 1998. Dialectical proof theory for defeasible argumentation with defeasible priorities (preliminary report). To appear in *Proceedings of the Fourth ModelAge Workshop on Formal Models of Agents*, Springer Lecture Notes in AI. Berlin: Springer Verlag.
Prakken, H. & Sartor, G. 1996a. A system for defeasible argumentation, with defeasible priorities. *Proceedings of the International Conference on Formal and Applied Practical Reasoning*, Springer Lecture Notes in AI 1085, 510–524. Berlin: Springer Verlag.
Prakken, H. & Sartor, G. 1996b. A dialectical model of assessing conflicting arguments in legal reasoning. In (Prakken & Sartor, 1996c), 175–212.
Prakken, H. & Sartor, G. (eds.) 1996c. *Logical Models of Legal Argument.* Dordrecht: Kluwer Academic Publishers (reprint of *Artificial Intelligence and Law* 4 (1996)).
Prakken, H. & Sartor, G. 1997a. Argument-based extended logic programming with defeasible priorities. *Journal of Applied Non-classical Logics* 7: 25–75.
Prakken, H. & Sartor, G. 1997b. Reasoning with precedents in a dialogue game. In *Proceedings of the Sixth International Conference on Artificial Intelligence and Law*, 1–9. New York: ACM Press.
Raz, J. 1975. *Practical Reason and Norms.* London: Hutchinson.
Raz, J. 1989. *The Authority of the Law.* Oxford: Oxford University Press.
Rescher, N. 1977. *Dialectics: a Controversy-oriented Approach to the Theory of Knowledge.* State University of New York Press, Albany, NY.

Rissland, E.L. & Ashley, K.D. 1987. A case-based system for trade secrets law. *Proceedings of the First International Conference on Artificial Intelligence and Law*, 60–66. New York: ACM Press.

Sartor, G. 1992. Normative conflicts in legal reasoning. *Artificial Intelligence and Law* 1: 209–235.

Sartor, G. 1997. Logic and argumentation in legal reasoning. To appear in *Current Legal Theory*.

Skalak, D.B. & Rissland, E.L. 1991. CABARET: rule interpretation in a hybrid architecture. *International Journal of Man-Machine Studies* 34: 839–887.

Skalak, D.B. & Rissland, E.L. 1992. Arguments and cases. An inevitable intertwining. *Artificial Intelligence and Law* 1: 3–44.

Summers, R. 1997. *Precedent in the United States*. In press.

Taruffo, M. 1975. *La Motivazione della Sentenza Civile* (Justification in civil judgement). Padova: Cedam.

Twining, W., & Miers, D. 1991. *How to do Things with Rules*. London: Butterworth.

Verheij, B. 1996. *Rules, Reasons, Arguments. Formal Studies of Argumentation and Defeat*. Doctoral dissertation University of Maastricht.

Vreeswijk, G. 1996. Representation of formal dispute with a standing order. *Research Report MATRIX, University of Limburg*.

Vreeswijk, G. 1997. Abstract argumentation systems. *Artificial Intelligence* 90, 225–279.

Williams, G. 1982. *Learning the Law*. London: Stevens.

Wroblewski, J. [1969] 1983. Justification of Legal Decisions. In J. Wroblewski: *Meaning and Truth in Judicial Decision*, 49–70. Helsinski: A-Thieto Oy. (First published in *Logique ét Analyse* 3 (1969)).