THE ROLE OF EXPLANATION IN REASONING FROM LEGAL PRECEDESENTS*

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The Role of Explanation in
Reasoning from Legal Precedents

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Abstract

A computational model for the process of reasoning from legal precedents to new
cases is outlined in which legal concepts consist of the facts of precedent cases together
with explanations for the satisfaction of the concept by each case. Classification of new
cases is accomplished by coercing the explanation structure of a precedent classification
onto the new case. Techniques for representing and mapping explanation structures are
presented.

1 Introduction

Much of legal reasoning can be described as the task of determining whether a given set
of facts is an instance of a legal concept. For example, determining whether one party
is liable to another for negligence is equivalent to determining whether the facts of the
case are an instance of the concept negligence liability. Legal reasoning is thus a form
of classification. To a greater extent than in more familiar forms of classification, such
as taxonomic classification or diagnosis, a significant part of expertise in law consists of
creating, anticipating, and weighing the persuasiveness of arguments for and against a given
classification. This process is heavily dependent upon reasoning from precedent cases.

In order to describe the role of reasoning from precedent cases in legal problem solving, it
is necessary both to outline the general process of legal reasoning and to describe the nature
of precedent cases themselves. It will be argued that much of the value of a case is in the
chain of reasoning employed in explaining its classification. Techniques for representing and
re-using detailed explanations are therefore critical to a computational model of precedential
reasoning in law.

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2 The Process of Legal Reasoning

Many of the characteristic activities of attorneys, including advocacy, legal planning, adjudication, and answering law school and bar examination questions share a common pattern. The analytical legal reasoning model is a proposed information processing model for this ubiquitous form of legal reasoning.

The input to the process typically consists of two basic elements. The first is a set of facts, usually in the form of a narrative history: a sequence of related events, together with any contextual or background information necessary to understand the events. The second component of the input is an analysis goal, which specifies the analytical task to be accomplished by the reasoner. An analysis goal consists of a set of relationships, termed goal relationships, whose applicability to some subset of the actors in the narrative is to be determined.

The analytical reasoning process itself consists of three steps. The first is legal situation recognition, the process of identifying sequences of events from the narrative history that might satisfy a given legal theory, such as negligence or worker’s compensation. The matching involves instantiating an abstract story or schema that corresponds to the legal theory [O’Neil 87] [Hastie & Pennington 86]. The potential legal claims recognized by an attorney are those associated with a theory for which the corresponding schema has been instantiated.

The second step, rule decomposition, is the process of repeatedly applying statutory or common-law rules until the goal relationship has been completely re-expressed in terms of legal relationships to which no more legal rules are applicable. Legal relationships to which no legal rules are applicable are “open textured” [Hart 58]. Any open-textured legal relationships that are neither clearly satisfied nor clearly unsatisfied by the instantiated story are issues in the analysis.

The final step is argument construction, the process of creating and evaluating plausible explanations for the satisfaction or non-satisfaction of legal relationships at issue under the analysis. Plausible arguments are constructed by mapping the explanations associated with relevant exemplars—precedent cases, and possibly paradigmatic hypotheticals [Christie 69]—onto the new case. If the instantiated story is incomplete, as it usually will be, the reasoning in precedent cases will indicate what facts must be established if the case is to share relevant similarities with a given precedent.

The primary focus of our research is on the third of these steps. A central research hypothesis is that case-based reasoning about whether a set of facts falls within a legal category requires, in general, determining whether there is an exemplar of the category such that the explanation associated with the exemplar is applicable to the given facts without extensive modification.

3 Category Structure and Classification

Classification with respect to open-textured legal concepts resists formalization because of the absence of any deductive scheme capable of deciding whether an arbitrary factual

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3 Participants in the AI and legal reasoning project at The University of Texas Department of Computer Sciences include Bruce Porter, Rich Mallory, Neil Cohen, and the author. All but Bruce Porter were attorneys in their former lives.
situation satisfies a given open-textured concept [Moore 81]. How then is it possible to automate problem solving with open-textured concepts?

The approach that we have adopted is to draw directly from the experience of Protos [Bareiss et al.], a learning apprentice for heuristic classification with a demonstrated capacity to perform at expert levels in domains characterized by ill-defined and polymorphic categories.

Protos performs classification in two steps. When a new case is input, Protos heuristically combines *reminding* compiled from past explanations, and uses the strongest reminding to select an exemplar. The similarity of the new case to the exemplar is then evaluated by attempting to construct an explanation of featural equivalence between the cases.

The development of Protos was guided by a body of psychological literature indicating that few natural concepts conform to what is now termed the *classical* model of a concept as a conjunction of necessary and sufficient attributes [Smith & Medin 81]. Discovery of phenomena inconsistent with the classical model, including the absence of known classical definitions for most objects, the existence of unclear or borderline cases, the common use of non-necessary properties in classification, and typicality effects, led to the proposal of alternative concept models.

In one such alternative model, termed the *exemplar* model, a concept is defined extensionally as consisting of distinct representations of some or all of its exemplars. Under this model, classification is performed by comparing the features of new cases with those of exemplars of relevant categories.

The exemplar and other prototype-based concept models are free from many of the problems observed with the classical model, but they do not in themselves account for the coherence of concepts [Murphy & Medin 85]. An understanding of why some collections of entities seem to form meaningful and useful categories whereas others seem absurd or useless is essential for classifying new instances. Unless it is known why a concept has a given set of instances, neither reliable classification with respect to the concept nor cogent justification for classifications will be possible.

The category model adopted by Protos steers a middle course between a purely intentional concept model, such as the classical model, and a purely extensional exemplar model. Protos retains both a featural representation of each exemplar of a category and an explanation of the relevance of each feature of the exemplar to the category. Categories are structured by a network of domain knowledge derived directly from explanations provided by the teacher, together with embedded exemplars.

Protos has demonstrated expert level performance in the domain of clinical audiology despite the polymorphy of diagnostic categories. Such performance is possible because retained explanations provide a domain theory for evaluating featural similarities between new cases and old. The experience of Protos strongly argues for a model of legal concepts that includes precedent cases, explanations for the resolution of the issues in those cases, and sufficient domain theory to support construction of explanations for new cases.

4 Explanation Generation vs. Explanation Re-use

It has been observed that it is the relevance and significance, not just the quantity, of similarities between a new case and a previous case that determines whether the classification of the previous case is applicable to the new one [Murray 82]. This observation emphasizes that legal precedents are more than just a collection of facts and a legal categorization.
Precedent cases also represent a bundled package of reasoning which may be applicable to future cases.

The central importance of the explanations associated with precedent cases has been recognized in the literature of legal philosophy. For example, [Raz 79] states that reasoning by analogy to past cases is "essentially an argument to the effect that if a certain reason is good enough to justify one rule, then it is equally good to justify another ...." In a similar vein, [Murray 82] observes that if a new case "furthers the same purposes of, or is justified by, the same factors as [a prior case], then the analogy is significant." Somewhat more bluntly, [Golding 80] states that "[I]t is only because explicit reasons are given for ... earlier decisions that they are of any use for later cases."

Although the success of Protos in reasoning with category structures embodying both exemplars and explanations suggests that the Protos paradigm is the logical approach to modeling open-textured concepts and argument construction, in one important respect the design of Protos is inappropriate for legal reasoning. Although Protos retains explanations of past classifications, explanations for new cases are generated dynamically. No problem arose from dynamic explanation generation in the domain of clinical audiology, because the domain theory of audiology is considerably less complicated than that of law. The search space for explanations of category membership is tractable because adequate explanations in audiology are seldom very complicated.

In law, by contrast, the explanation of satisfaction of a legal relationship by a given factual situation can be very complex. As a result, the search space for possible legal arguments is apparently intractable. Moreover, it seems to us that attorneys seldom generate such explanations from whole cloth. Instead, an argument for, or explanation of, a legal classification is generally a modification of a past explanation of category membership.

The challenge presented by legal reasoning is therefore to extend the Protos paradigm by explicitly associating explanation structures with precedent cases and by showing how these explanation structures can be used to reason about new cases. The recognition that explanation structures of legal precedents must be re-used is consistent with the analysis of re-use of everyday explanations in [Schank 86].

Research thus far has focused on investigating the analytical legal reasoning framework described in Section 2, developing a computational model of the explanation structures of legal opinions, and modeling the process of mapping explanations for the resolution of issues in a precedent onto new factual situations. The next step will be to construct a case library spanning a small legal domain. We plan then to construct a system for applying plausible arguments drawn from the library of precedents to new factual situations.

The next section presents an example from the domain of worker's compensation law that illustrates some of the techniques we have used for representing explanation structures in precedent cases and mapping them onto new cases.

5 Explanation Structures in Legal Opinions

The domain of law is unique in having explicit, official explanations of the classification of cases with respect to legal categories. Such official explanations are embodied in judicial opinions, the written justifications for legal judgments. Expressed in terms of the analytical legal reasoning model, the elements of a legal opinion include the following:

- a narrative history
• a rule decomposition of the goal relationships of the case

• explanations for the evaluation of nondecomposable relationships (those to which no further statutory or common law rules are applicable) in terms of the facts of the narrative history.

A formal model of the explanation structure of a legal opinions must be capable of representing each of these elements.

A typical worker’s compensation case involving transportation with both personal and business purposes which we have studied is Janak v. Texas Employers Ins. Assoc., 381 S.W.2d 176 (1964). The facts of Janak can be briefly summarized as follows:

Janak was employed as an oil driller in central Texas. Because the job entailed strenuous work under sunny and hot conditions, it was customary for the oil drillers to bring ice to the job site to chill water for drinking. No ice was available on the direct route from Janak’s home to the work site, so on the day of the accident Janak took an indirect route that led by a store that sold ice. After he purchased the ice, but before he rejoined the direct route, Janak was involved in an accident.

Briefly summarized, the court in Janak held that Janak’s injuries were compensable under worker’s compensation because they occurred “in the course of” Janak’s employment. Injuries occurring during transportation are ordinarily excluded from compensation, but an exception exists if the employee is “directed in his employment” to travel as he did. The court found that there was sufficient evidence for the jury to have found that Janak was implicitly directed to take the detour to get ice, because ice was “reasonably essential for” the continuance of the drilling activities, given the hot conditions and the strenuous nature of the job.

5.1 Explanation representation

The first element of the explanation structure of Janak is the representation of the events of the case, which requires representing habitual and anticipated actions and a network of goals and plans. We have adopted a semantic network representation that includes activities, states, individuals, collections, and “action sequence categories,” exemplar-based categories of event sequences graded by typicality, similar to the E-MOP’s described in [Schank 82]. Links between nodes include causal, temporal, and intentional links.

The second element of the explanation structure is a representation of the rule decomposition of the goal relationship of Janak, that is, the set of statutory and common law rules that the court used to justify its decision. For each step in the decomposition, it is necessary to identify the following items:

• the relationship being decomposed

• the applicable rule

• the authority for the rule

• the instantiation of the rule’s antecedents by the facts of the case.
These items, which correspond to the conclusion, warrant, backing, and data, respectively, in Toulmin's model of argument structure [Toulmin 58], are linked to a rule explanation node.

The third element of the explanation structure of an opinion is the representation of explanations for nondecomposable relationships. Thus far, we have identified two types of explanation nodes in addition to rule explanation nodes useful for representing such relationships. The first, termed an ordinal explanation node, provides an explanation for variable standards [Gardner 85] such as the concept "reasonably essential for" in Janak. Such concepts can be explained by the dimension (cf., [Rissland & Ashley 87]) over which the standard ranges—in this case criticality—together with a partial ordering of examples and some explanation for the values along the dimension of the examples. For example, the court in Janak contrasted the facts of the case with two hypotheticals. The court observed that had the deviation been for the purpose of obtaining tools essential to the drilling operation, the travel would "clearly have been impliedly directed by the employer", whereas if the deviation had been for the purpose of buying a particular kind of hamburger for lunch, the travel would clearly not have been "impliedly directed" by the employer. Janak, 381 P. 2d at 182. Ice to chill drinking water falls somewhere in between these extremes.

A second form of explanation node is necessary to represent the explanation of qualitative values ("q.v.'s"), such as the high criticality of ice or the low criticality of a particular kind of hamburgers, upon which the partial ordering of examples depends. Such nodes, termed qualitative valuation nodes, explain qualitative values by showing their functional dependency [Kuipers 84] upon other qualitative values. For example, Figure 1 represents an explanation for the qualitative value of the criticality of ice by means of a qualitative valuation node. The criticality of ice for the drilling activities of the employees is explained by the high qualitative value for the employee's water and cooling needs, together with the functional dependency of the criticality of ice upon those needs.

The functional dependency between the criticality of ice and the need for water and
cooling in Figure 1 is explained by a common sense rule of amelioration. In terms of the facts of Janak, the rule is that the hotter and thirstier an employee performing an employment activity is, the more critical drinking cool water is to the employment activity. The core functional relationships underlying this explanation are shown in Figure 2. The general form of the rule is that if the value of a parameter (e.g., water and cooling need) reduces the effectiveness of activity1 (e.g., drilling) and some activity2 (e.g., drinking cool water) reduces the value of the parameter (e.g., reduces water and cooling need), then the degree of criticality of activity2 is a direct function of the value of the parameter.

A rule of this nature is not likely to be made explicit in a judicial opinion because the importance of reducing states that interfere with desirable activities is both painfully obvious and difficult to articulate at an appropriate level of abstraction: it is “just common-sense”. At the same time, applying this rule is the crucial step in justifying the criticality of ice to Janak’s job activities.

The two M− relationships in Figure 2 are explained by naive physiological knowledge, of which a sketch is set forth in Figure 3. The figure indicates that the qualitative value of certain physiological needs (such as thirst) is increased by work activities and increases spontaneously over time. The value of such needs is decreased, however, by need satisfaction activities (such as drinking water). Such needs, in turn, decrease the effectiveness of the work activities of the employee who experiences them. The spectrum of possible values of this diminution of effectiveness ranges from no impairment to death.

5.2 Explanation mapping

How can the explanation structure of a precedent case be applied to a new case? Suppose that our system is presented with a new case:

M is a maintenance man whose job includes keeping various machinery in good repair. On arriving at work one day, M is told that a certain machine needs work, but he discovers that he has left his socket wrench at home. M has a crescent wrench, but he knows from past experience that he will be able to perform the job much more quickly and efficiently with socket wrench. He therefore decides
to drive back home to get it. On the way, $M$ is involved in an accident and injured.

Does $M$ have a worker's compensation claim? The first step in analyzing the new case is the rule decomposition of the goal relationship, worker's compensation liability. Under one possible rule decomposition, the main issue will be whether the socket wrench was reasonably essential for the performance of $M$'s job, an issue for which Janak is a precedent. The task of the system will therefore be to coerce Janak's explanation for "reasonably essential for" onto the new case.

The ordinal explanation node of the Janak explanation structure represents that "reasonably essential for" is a variable standard ranging over criticality. We are given that the use of a socket wrench increases the effectiveness of $M$'s employment activity by some significant amount. A successful analysis will relate the increase of effectiveness caused by use of the wrench to the wrench's criticality. Under such an analysis, evidence that the wrench would increase of job effectiveness will tend to establish that the socket wrench was therefore reasonably essential to the job activities.

In the Janak explanation structure, drinking iced water reduces physiological needs—thirst and excessive warmth—that interfere with job effectiveness. When such physiological needs are high, drinking iced water increases efficiency. Indeed, as represented in Figure 2, the higher the physiological needs, the greater the increase in job effectiveness over what it would have been without the iced water, and the greater the criticality of ice to the employment activities. Ice was reasonably essential to the job activities because the heat and strenuousness of the job made these physiological needs high.
Given that the physiological needs were high in Janak, the connection between need satisfaction activities and effectiveness shown in Figure 2 can be simplified to a single M+: drinking iced water increased job performance. Thus, we have a case where a state (having ice) has high criticality because it is a prerequisite for an activity (drinking iced water) that increases job effectiveness. Moreover, there is a direct connection between the increase in job performance and the degree of criticality. Figure 4 shows this simplified explanation applied to the hypothetical case.

The increase in job effectiveness caused by using a socket wrench has been substituted for the effect of drinking water, and $\Delta$, the amount of the increase in efficiency resulting from using the wrench, has been substituted for the qualitative value of physiological needs, which determine how much drinking water can improve drilling performance. The result is a modified explanation structure that can entitle one to say that, under the reasoning of Janak, evidence that the socket wrench could greatly improve job efficiency would tend to establish that the socket wrench was reasonably essential to the performance of $M'$s job duties. This, in turn, would establish that transportation to obtain the wrench was in furtherance of those duties.

6 Conclusion

We have argued that a case is more than just a set of facts. A case is also a bundle of explanations that can be applied to future situations. Recognizing a new case means not just matching its features to those of a former case, but forcing a match between a known explanation and new facts. This requires both retention of explanations and a sufficiently detailed domain theory to support extensive modifications of explanations to accomodate new situations that differ significantly from past experience.

References


