Critical Questions in Computational Models of Legal Argument

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ABSTRACT

Two recent computational models of legal argumentation, by Verheij and Gordon respectively, have interpreted critical questions as premises of arguments that can be defeated using Pollock's concepts of undercutters and rebuttals. Using the scheme for arguments from expert opinion as an example, this paper evaluates and compares these two models of critical questions from the perspective of argumentation theory and competing legal theories about proof standards for defeating presumptions. The applicable proof standard is found to be a legal issue subject to argument. Verheij's model is shown to have problems because the proof standards it applies to different kinds of premises are "hard-wired" into the system. Gordon's model overcomes these problems by allowing different proof standards to be assigned to each issue and by supporting arguments about proof standards within the same framework. These differences are minor however compared to the insight gained from these models jointly about the theory of argument schemes and critical questions. They show how schemes can be used to implement tools for constructing arguments, and not just for classifying arguments ex post facto, and help clarify how critical questions confound declarative knowledge about conditions for using argument schemes with procedural knowledge about how to evaluate and criticize arguments made using these schemes.

Categories and Subject Descriptors

H.4.2 [[**Information System Applications**]: Types of Systems—*decision support*; J.1 [**Computer Applications**]: Administrative Data Processing—*law*

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Argumentation, Argument Schemes, Critical Questions, Legal Reasoning Support Systems, Artificial Intelligence and Law

1. INTRODUCTION

Argument schemes are "forms of argument" for "stereotypical patterns of human reasoning" [1]. They can be viewed as inference rules for presumptive reasoning. Argument schemes have been used primarily to classify, ex post facto, arguments in natural language texts. For this purpose, the schemes are used as patterns to support the *reconstruction* of the form of an argument during the interpretation of the text. This is in stark contrast to the usual function of inference rules, as tools for deriving new conclusions from premises.

Recently, work in AI and Law has begun to implement models of argument schemes which does justice to the inference rule conception of argument schemes, by modeling them in such a way that they can be used as tools to find, construct or generate arguments. The earliest work of this kind models particular schemes for legal argument, such as various schemes for arguments from evidence [6]. In this paper we want to take a closer look at two recent AI and Law models, by Verheij [8] and Gordon [2], which both try to model argument schemes in a more general way. Of particular interest to us here is the way they both model some kinds of critical questions as additional premises which can be presumed to be acceptable or not under certain conditions and defeated using various kinds of defeasible arguments.

Our goal in this paper is to present these two computational models of argument and evaluate them from the perspective of the philosophy of argumentation and a legal analysis of the concept of presumptions.

We begin in the next section by presenting an example argument, using the scheme of argument from expert opinion, to help us to illustrate various points more concretely. Section 3 presents the critical questions for arguments from expert opinion. Section 4 introduces the idea of representing some critical questions as implicit premises. Section 5 is a brief summary of the current legal discourse about the proof required to defeat presumptions. Section 6 and Section 7 present Verheij's and Gordon's computational models of argument, respectively. Section 8 completes the paper by evaluating and comparing these models in light of the insights from the philosophy of argumentation and the legal debate about the proof required to defeat presumptions presented earlier. This closing section also uses these two models, conversely, to reflect on the theory of critical questions.

2. ARGUMENT FROM EXPERT OPINION

Let's take the following argument as an example; it represents a common kind of evidence that might be brought forward in a trial:

> The medical examiner (ME) said that the tissue sample found at the crime scene matches the DNA of the suspect. Therefore, the tissue sample found at the crime scene matches the DNA of the suspect.

This argument looks like it is persuasive on the grounds that the ME is an expert in the domain of DNA testing. Thus one way to analyze this argument is to use the scheme for the argument from expert opinion. This scheme (often also called appeal to expert opinion in logic textbooks) was formulated in [11, p. 201] as follows.

Argument from Expert Opinion

Major Premise: Source E is an expert in subject domain S containing proposition A.

Minor Premise: E asserts that proposition A (in domain S) is true (false).

Conclusion: A may plausibly be taken to be true (false).

To apply this scheme to the argument above, we need to interpret the argument to identify the expert, E, the subject domain, S, and the proposition, A. This is not a simple matching process, as the sentences in the argument do not have the same form as the premises in the argument scheme. For example, the subject domain is not explicitly mentioned in the text of the argument. The text can be interpreted in various ways, as referring to the domain of medicine, forensic medicine, medicine as applied to forensic evidence, or something of the sort. Only once the argument has been interpreted so as to find values for all the variables in the scheme, can the scheme be used to categorize it as an argument from expert opinion.

Legal arguments are not always the same as everyday conversational arguments. If this were an everyday conversational argument not being used in a legal setting, we could just go ahead and assume that it fits the scheme above, and base our analysis and evaluation on this assumption without getting into too much trouble. But law is evolving its own standards for analyzing and evaluating arguments based on expert opinion. First there was the Frye[1] standard, and now with the advent of Daubert[2] and newer cases, other standards have not only been proposed, but also backed by legal precedents on how a court must introduce and handle expert opinion evidence. Bypassing all these legal considerations at this point, we go on to examine hypothetically how the example argument could be evaluated using current methods of argumentation for conversational arguments.

[1] *Frye v. United States* (293 F. 1013 D.C. Cir. 1923)
[2] *Daubert v. Merrell Dow Pharmaceuticals* (509 U.S. 579)

3. CRITICAL QUESTIONS

Given that the example argument can be so identified and analyzed as an instance of the scheme of argument from expert opinion, the next problem is how to evaluate its strength. The basic method proposed in [11, p. 223] makes use of *critical questions* associated with each argument scheme. Six such critical questions have been identified for arguments from expert opinion:

1. *Expertise Question*: How credible is E as an expert source?
2. *Field Question*: Is E an expert in the domain S?
3. *Opinion Question*: What did E assert that implies A?
4. *Trustworthiness Question*: Is E personally reliable as a source?
5. *Consistency Question*: Is A consistent with what other experts assert?
6. *Backup Evidence Question*: Is E's assertion based on evidence?

Critical questions, as applied to everyday conversational arguments, are devices that can be used to pinpoint potential weaknesses in a given argument. They can be applied when a user is confronted with the problem of replying to that argument, or making some assessment of what the argument is worth and whether to accept it. Here, the expertise question challenges the premise that the witness, E, has expert knowledge in some domain, or practical mastery of a well-defined or codified skill. Credibility is the notion that because E is an expert in a domain of knowledge, E is in a position to know, and therefore what E says has more value as evidence that what a non-expert would say. The field question challenges the premise that the domain of expertise of E is the relevant domain, S. The opinion question calls into doubt whether the witness literally testified that A is the case, instead of some other statement that may or may not imply A. The trustworthiness question challenges the honesty and objectivity of E as a source of knowledge. The consistency question challenges the correctness of the expert's testimony with contradictory statements by other acknowledged experts. Finally, the backup evidence question challenges the expert to support his claim with evidence.

In the case of the example argument, one natural critical question to begin with would be to ask about the ME's qualifications. Is she a medical doctor? Is she a specialist? How much experience does she have with forensic evidence cases? Of course, in law such an argument could be the subject of much more detailed analysis and evaluation. The ME might be cross-examined in a trial, for example, and asked specific questions. Other experts might be brought in. In some of the more difficult cases, there might be a battle of experts, and critical question 5 could be fought out.

4. CRITICAL QUESTIONS AS IMPLICIT PREMISES

The common way of diagramming arguments, as presented by Walton in [10], does not explicitly provide a way to include critical questions in the diagrams. Chris Reed, one of the developers of the Araucaria [7] computer program for argument diagramming, posed the question, in the spring of 2001, whether critical questions can be understood as implicit premises of an argument which can be made explicit and visualized in diagrams as additional premises. Examining this question in the context of the scheme for argument from expert opinion, it appears that most of the six critical questions indeed can be seen as implicit premises, with the exception of questions 4 and 5. Let's first take a look at the critical questions which can be viewed as implicit premises:

1. When you put forward an appeal to expert opinion, you assume, as part of the argument, that the source is credible, or has knowledge in some field.
2. You assume that the expert is an expert in the field of the claim made.
3. You assume that the expert said something, made some pronouncement, from which the claim can be extracted by inference, or in some cases, even by direct quoting.
6. You assume that the expert's assertion was based on some evidence within the field of his or her expertise.

The argument doesn't make much sense, or hold up as a plausible appeal, without these assumptions being part of it. Questions 4 (trustworthiness) and 5 (consistency) are different however. One does not assume the witness is untrustworthy or that his testimony is inconsistent with the testimony of other expert witnesses. To challenge the trustworthiness of a witness, evidence of bias or dishonesty must be produced. Similarly, to challenge the consistency of the expert's testimony, contradictory testimony of other experts in the same field say must be produced as evidence. The criticism needs to be backed up by telling us what these other experts have said and showing how these statements conflict with what our expert said. The difference between these two kind of critical questions may be one of burden of proof. You could say that critical questions 4 and 5 have a positive burden of proof attached, whereas the other critical questions do damage just by being asked. Appropriate answers must be provided for critical questions of this latter type or the argument from expert opinion will fail.

5. LEGAL PRESUMPTIONS

Our discussion about whether critical questions can be viewed as implicit premises suggests there may be two types of critical questions, depending on whether or not the condition implied by a question can be presumed to be answered affirmatively. To shed further light on this issue, perhaps it would be helpful if we first take a brief look at how presumptions have been analyzed by legal theorists.

A presumption is a device used in law to move argumentation in a tribunal ahead by provisionally accepting a proposition even though there is insufficient evidence to prove it or disprove it. A presumption can be accepted as long as the evidence is insufficient to disprove it. An example is the legal presumption of death used in cases of wills and settlement of estates. If a person has disappeared with no trace, after a designated number of years, he can be presumed to be dead for purposes of settling the estate. In such a case, it can't be proved by sufficient evidence that the person is dead. No body may have been found. But still, it can be presumed legally that he is dead. It is an important property of presumptions that they are defeasible. Acceptance is provisional, and if new evidence comes into a case, the presumption that was once accepted may now have to be given up.

Although presumptions are commonly used in law, and seem fundamental to legal argumentation, how presumptions should be evaluated for acceptance or rejection by logical standards is an unsettled problem. There are two different theories of presumption that have been offered in law. They differ mainly on the question of how much evidence is sufficient to refute a presumption. What this difference amounts to can be seen by considering the Letter Example from Chapter 4, 'Burdens and Presumptions', of [3, p. 107]:

> The respondent suffered a fall on a dark stairway in an apartment building. He sued the proponent, the building's owner, claiming that she did not keep the stairway in a safe condition, because the lighting did not work properly. To prove notice, the proponent claimed she mailed a letter to the respondent, informing him that several of the lights in the stairway no longer worked.

According to [3, p. 103], there is a defeasible rule of law that creates a presumption that the letter was received, subject to exceptions. The presumption states that a letter properly addressed, stamped, and deposited in an appropriate receptacle is presumed to have been received in the ordinary course of the mail. Unless the presumption created by this rule is defeated, the properly addressed, stamped, and deposited letter will be deemed to have been received in what is considered to be the ordinary amount of time needed in that delivery area. How the presumption works in such a case is fairly clear. The defeasible rule sets up a presumption in much the same way as the rule above about the presumption of death did.

The first of the two theories about how much evidence is required to defeat a presumption is the Thayer-Wigmore *bursting bubble* theory [3]. According to this theory, a presumption is defeated by the introduction of any evidence that counts against it. This theory holds presumptions to be weak, comparing them to "bats flitting in the twilight, but disappearing in the sunshine of actual facts" [3, p. 109]. Suppose the party claims that he always checks his mail every day and that he is sure he did not receive the letter. According to the bursting bubble theory, that would be enough evidence to enable a jury to decide to defeat the presumption of receipt of the letter.[3, p. 110].

According to the second theory, the Morgan-McCormick

theory, once a presumption has been accepted, the burden of disproving it shifts to the opponent [3, pp. 111–112]. On this theory, "the respondent must prove it more likely than not he had not received the letter or suffer a finding that he did" [3, p. 112].

Thus the two theories differ on how strongly presumptions hold. The Morgan-McCormick theory considers the bursting bubble theory as giving too slight and evanescent a holding power to them [3, p. 111]. The bursting bubble theory allows even a small amount evidence against the presumption, once it turns up, to be sufficient to defeat the presumption. The Morgan-McCormick theory seems to demand a higher quantity of evidence. It requires that the presumption to remain accepted until sufficient evidence to disprove it has come in. In the Morgan-McCormick theory, there is a shift in the burden of proof. Once the presumption has been put forward by one side in a dialogue, and both parties accept it, the other side then has to disprove it before it is defeated. The Morgan-McCormick theory could therefore be called the *shifting burden of proof* theory. Which theory is more accurate as an account of how legal presumptions should be evaluated is an unsettled issue. It could be that one theory is right and the other is wrong. Or it could be that there are different kinds of presumptions with varying strengths in different cases, and hence different standards for evaluating what quantity of evidence should be required to defeat a presumption.

6. VERHEIJ'S APPROACH

Recently, there have been two proposals from the field of Artificial Intelligence and Law for modeling argument schemes, including critical questions, one by Verheij [8] and the other by Gordon [2]. Taking the above considerations from argumentation and legal theory into account, we discuss both of them in this paper, beginning with Verheij's work in this section.

Verheij distinguished four different roles of critical questions in argument [8, Section 5]:

1. criticizing a schemes' premises,
2. pointing to exceptional situations in which the scheme should not used,
3. setting conditions for a scheme's use, and
4. pointing to other possible arguments relevant to a scheme's conclusion.

Concerning the first role, Verheij argued that there should be no need for explicit critical questions that merely ask whether a premise of a scheme is true or not, since "a precondition of the use of *any* [his emphasis] scheme is that its premises are true, well supported, justified, ..." [8, section 5]. If you look again at the six critical questions for the scheme for argument from expert opinion above, the first three arguably can be considered redundant in this way. The first two critical questions ask whether the witness is an expert and, if so, whether the statement asserted is within his domain of expertise. The major premise of the scheme for argument from expert opinion explicitly includes both of these conditions. The third critical question asks what E asserted that implies A, although the minor premise of the scheme appears to require E to have directly asserted A, not some other statement.

When it comes to formalizing schemes, Verheij's proposal for reducing redundancy makes sense. Part of the formalization required is a general condition that an argument fitting a scheme can, and indeed always should, be evaluated by asking whether the premises are in fact true in the given case.

Verheij's way of modeling the other roles of critical questions draws upon Pollock's distinction between two kinds of defeat relations between arguments, called undercutters and rebuttals [4]. Drawing this distinction in legal cases has proved tricky, but what it amounts to can be quickly explained as follows. A rebuttal is an argument if favor of a conclusion which is the negation (opposite) of the original conclusion. An undercutter, on the other hand, attacks the inference that was used in the original argument to derive the conclusion from the premises. The undercutter may, for example, cite an exception to the rule used in the first argument.

Verheij has developed a logic for defeasible reasoning, called DefLog, which is capable of representing both undercutters and rebutters. There is not room to present DefLog in detail here, but it should suffice for our purposes to point out that it defines a language for representing statements, including defeasible rules, and a (nonmontonic) inference relation between sets of these sentences. Since rules are statements in this logic, they can be used both as premises and conclusions in other rules. The logic includes a unary operator on sentences for *dialectical negation*.

Argument schemes are modeled as defeasible rules in DefLog. The various roles of critical questions are all modeled using such rules in Verheij's approach. Critical questions of the first, which merely restate premises of a scheme, can be safely ignored, as discussed previously. Critical questions of the second, which point to exceptional situations, are modeled as undercutting rules of the following form, negating the applicability of other rules, using the operator for dialectical negation:

```
exception-1 ->
   x(premise-1 & ... & premise-n -> conclusion)
```

As illustrated here, we are using in this paper, as a concrete syntax for DefLog rules, `->` as the operator for the defeasible conditional, `x` as the unary operator for dialectical negation and `&` as a conjunction operator.

Since the premises of rules in DefLog are presumed not to hold, such exceptions will not undercut the rule unless they are supported by further statements.

Critical questions of the third kind, setting conditions on the applicability of a scheme, are modeled in Verheij's approach as DefLog rules of the following form:

```
condition-1 ->
   (premise-1 & ... & premise-n -> conclusion)
```

An important point to make is that these conditions are ordinary premises and are thus **presumed not to hold**, just like other premises. They must be either explicitly assumed, by adding the condition to the theory of the case, or derivable from other statements. The above rule is logically equivalent in DefLog to the following version:

```
condition-1 & premise-1 & ... & premise-n ->
    conclusion
```

Finally, critical questions of the fourth kind, pointing to other arguments relevant to a scheme's conclusion, are modeled simply as additional rules having the same conclusion or, for rebuttals, the opposite conclusion, using the operator for dialectical negation. That is, given a rule for `conclusion-1`, rebuttals would be modeled using rules of this form:

```
premise-1 & ... & premise-n -> x(conclusion-1)
```

Verheij has also developed a method and computer software for diagramming arguments, called ArguMed [9], which is compatible with DefLog. In Verheij's diagramming method, arguments which undercut other arguments are drawn using a device known as *entanglement*: the given argument is represented on the diagram in the usual way as an arrow (representing a linked or convergent pattern) joining a set of premises to a conclusion; the undercutter is represented as another arrow pointing to the original arrow.

7. GORDON'S APPROACH

In a recent paper [2], Gordon presented a computational model of defeasible argument, including Walton's concept of argument schemes, for use in legal reasoning support systems. Building on ontologies from the Semantic Web, the model is intended to provide an integrating framework enabling diverse models of a variety of legal argumentation schemes, such as arguments from legislation, precedent cases and evidence, to be used together in a comprehensive system supporting argument construction, selection and evaluation, as well as the justification of legal decisions. Argument schemes in this model are interpreted as interactive, heuristic search procedures, to be used to help find and construct arguments during legal discourse.

There is room here only to provide a brief sketch or overview of Gordon's model of argumentation. Please see his recent paper [2] for further details. Gordon's computational model is not a theorem prover for a formal logic. Rather, it defines structures for representing various elements of argumentation, including atomic propositions, arguments, cases, issues, argument schemes and proof standards, and defines functions for properties of these elements, in particular the presumptive validity of arguments and the acceptability of atomic propositions. That is, the model is high level, functional specification of a computer program which can be implemented in any programming language.

Inspired by the work Verheij discussed in the previous section of this paper [9], three of the four different roles of critical questions are modeled in Gordon's system using different kinds of premises, called antecedents, presumptions and exceptions. (The fourth role of critical questions is handled not by premises, but with additional arguments pro or contra the conclusion of the first argument.) The antecedents of an argument are not presumed to be acceptable, but must be supported by further arguments in order to have a chance of being evaluated as acceptable. Presumptions are superficially similar to Verheij's conditions, except that they are deemed acceptable unless called into question. Gordon's model of argument includes an explicit construct for *issues*. A proposition is called into question, or put *at issue*, by adding an appropriate issue to the model of the case, using a speech act provided by some argumentation protocol. Finally, exceptions are similar to exceptions in Verheij's model, premises which are not assumed acceptable but which can block or undercut the argument if put at issue and supported by further argument.

The data type for arguments is defined as follows:

```
type argument =
{ id: id,
  direction: {pro, con},
  consequent: atom,
  antecedent: atom list,
  presumptions: atom list,
  exceptions: atom list }
```

Here is an example record, illustrating how this type of data structure can be used to represent an argument from expert opinion:

```
id: arg-1
direction: pro,
scheme: argument-from-expert-opinion,
consequent: (mentally-ill defendant true),
antecedents:
   (isa e expert-testimony)
   (domain e d)
   (assertion e (mentally-ill defendant true))
   (within d (mentally-ill defendant true)),
presumptions:
   (credible e true)
   (based-on-evidence e true),
exceptions:
  (trustworthy e false)
  (consistent-with-other-experts e false)
```

Arguments are evaluated to determine the acceptability of propositions, considering all the arguments which have been made thus far in the discourse and applicable proof standards. Each issue of a case is assigned a proof standard. Which proof standard is applicable to an issue may be an legal issue in its own right, requiring further argumentation to clarify.

Arguments are evaluated using abduction. The presumptions of arguments which have not been put at issue, called

assumptions, play the role of hypotheses. A *context* a subset of these assumptions. A *supporting context*, `C`, of a proposition at issue, `p`, is a minimal context which, together with the accepted propositions of the case, called *facts*, and a set of conditional propositions derived from the arguments, called *justifications*, entails `p`. Classical propositional entailment, which is monotonic, is used. Defeasible reasoning is achieved not by using a nonmonotonic logic, but by using abduction with classical logic. An *extension* is a maximally consistent set of propositions. Proof standards are defined using extensions. For example, the 'scintilla of evidence' proof standard is defined so that a proposition meets this standard iff it is a member of at least one extension. And the 'beyond a reasonable doubt' standard is defined so that a proposition meets this standard iff it is a member of every extension.

Again, presumptions and exceptions are handled differently in this model of argument evaluation. Presumptions, so long as they are not at issue, may be assumed. Exceptions may not be assumed, but require, like ordinary antecendents, support from further arguments. Accepting an exception does not rebut the conclusion of the argument, but rather acts as a kind of undercutting defeater cancelling the support of the argument for its conclusion. See [2] for the technical details of how this is achieved. The basic idea is to introduce applicability assumptions to the justifications generated from arguments. A justification is generated for each exception to express the constraint that the applicability assumption and the exception cannot both be consistently accepted in the same context.

8. DISCUSSION

Although Verheij and Gordon both model critical questions using premises of defeasible arguments, as we have seen there are numerous significant differences between the two systems:

- Whereas Verheij models arguments, including their critical questions, as a set of statements in a formal logic for defeasible reasoning, Gordon models them as data structures in a functional specification of a computer program;
- Specific argument schemes can be represented using Verheij's system, as defeasible rules in DefLog. Gordon's system is not intended for representing or implementing specific schemes, but rather as a way of integrating diverse components for supporting legal reasoning, where each such component may implement one or more argument schemes. In term's of Prakken's layered model of dialectical systems [5], Gordon's model is an *argumentation framework* for recording and evaluating arguments and Verheij's model is an example of the *logic layer* for representing knowledge and generating arguments. It should be possible to use Verheij's system as one component for generating arguments for Gordon's system, together with components for other legal argument schemes, such as arguments from precedents using case-based reasoning.
- Most relevant for the purposes of this paper, although both systems model critical questions as premises, arguably only Gordon's system provides a way to model the standard of proof which should be associated with these premises in a legally adequate way.

This last difference requires further discussion. Recall that there are competing legal theories about the appropriate proof standard for defeating legal presumptions, the Thayer-Wigmore bursting bubble theory and the Morgan-McCormick theory. Verheij's approach implements the bursting bubble theory for critical questions which play the role of exceptions. The slightest argument supporting the exception can suffice to undercut the prior argument. Moreover, Verheij's approach to modeling critical questions which set conditions on the schemes use does not allow these conditions to be presumed at all. Rather, just like ordinary premises, they must first be supported with further arguments. That is, Verheij's system may allow an exception to be accepted with too little proof and requires too much proof of a condition.

Gordon's system handles exceptions and conditions (called presumptions) in a more uniform way. All presumptions which are not at issue are deemed acceptable and all exceptions which are not at issue are deemed not acceptable. In both case, these defaults hold only so long as they are not at issue. Once a party has made an issue out of an exception or presumption, their acceptability depends on the applicable proof standard. Proof standards for both the Thayer-Wigmore and the Morgan-McCormick theories can be modeled. Which theory is applicable is a legal issue which can be addressed in the context of arguing particular cases. Gordon's model allows the issue of which proof standard to apply to be handled, within the same case model, along with arguments about other issues, but it must be admitted that the model does not currently automatically assign proof standards chosen as a result of such discussions to issues in the model.

These differences between the two approaches are minor compared to their joint contribution to the understanding and analysis of argument schemes. They both illustrate that schemes can be understood not only as patterns for classifying, ex post facto, arguments appearing in natural language texts, but also as tools for finding, constructing or generating arguments, to help people to argue effectively. Argument schemes are like cookie cutters. But they have been used up until now mainly to squeeze the baked cookies back into the cutters to classify them as stars, moons, hearts and so on. In Verheij's and Gordon's work, the cutters are used to make cookies.

And they both help to make clear that the original conception of critical questions confounds declarative knowledge about conditions for using schemes and exceptions blocking the use of schemes with procedural advice about how to evaluate or criticize arguments. This confounding of two kinds of knowledge in the concept of critical questions is the reason why the premises of argument schemes were reiterated, apparently redundantly, in the critical questions: to remind the user to question the acceptability of the premises when evaluating the argument. The models of Verheij and Gordon, typical for Artificial Intelligence research, cleanly

separates declarative and procedural knowledge. Thus, just as the work in AI and Law has been inspired and informed by the philosophy of argumentation, the precision of computational models such as these has proven useful for helping to advance this field of philosophy.

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