Using Argumentation Schemes to Model Legal Reasoning

Trevor Bench-Capon and Katie Atkinson*

Department of Computer Science, University of Liverpool,
Liverpool, UK

Abstract

We present argumentation schemes to model reasoning with legal cases. We provide schemes for each of the three stages that take place after the facts are established: factor ascription, issue resolution and outcome determination. The schemes are illustrated with examples from a specific legal domain, US Trade Secrets law, and the wider applicability of these schemes is discussed.

1 Introduction

Reasoning with legal cases, especially as conducted in common law jurisdictions such as the UK and USA, is a form of argumentation much studied in Artificial Intelligence and in computational argumentation. The formal procedure within which it is conducted and the extensive documentation which records the argument presented for each side and an assessment of these arguments make it a fruitful area for study. As described in [35], there may be several types of reasoning involved, including the use of rules, the balancing of factors, analogy and the use of policies to achieve particular purposes. All of these have been modelled in AI and Law, and this work suggests that reasoning with legal cases can been seen as going through a series of stages at which different reasoning styles are appropriate. This view will be elaborated in Section 2.

One way of modelling a reasoning task [24] is to present it as a set of argumentation schemes [38]. In this paper we will use this method to articulate the reasoning required at each of the stages.

Although legal reasoning is worthy of study in itself, we believe that the insights are also applicable to other, less formal, domains where it is necessary to balance reasons for and against particular options to come to a decision. While there are some similarities with practical reasoning tasks, such as choosing

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which restaurant to go to (e.g. [5]) and which car to buy, (e.g. [17]), we suggest that the methods are more applicable to classification tasks, because the use of binding precedents to determine preferences is not applicable in many domains, whereas the examples used to train a classification system can act like a set of precedents in a settled domain of law where preferences are resolved. Legal reasoning is indeed used as the model for explaining the output of machine learning systems in [26] for several diverse classification tasks: customer churn, poisonous mushrooms and university admissions.

2   Stages in Reasoning with Legal Cases

A legal case will be governed by laws which state what the plaintiff or prosecution must show to establish their claim. The law can be seen as a set of definitions and represented as rules [32]. At some point, however, the terms in the rules will be undefined [33], and it must be determined whether or not these terms apply in the particular case. This gives rise to a set of what are termed *issues* in AI and Law [1]. These issues must be resolved in favour of either the plaintiff or the defendant, and the reasons for each side are termed *factors* in AI and Law [1]. Which reasons apply in a given case will be determined by the *facts*. The facts themselves will be decided on the basis of the *evidence* is presented.

Thus deciding a legal case involves

- accepting facts on the basis of the evidence

- ascribing factors on the basis of the facts

- resolving the issues on the basis of the factors

- deciding the outcome of the basis of the issues

We will not say more about reasoning with evidence here, since it is not especially legal. In common law jurisdictions, deciding which facts to accept is the responsibility of lay jurors, not legal professionals, and the reasoning as to what to believe is no different from that used in everyday life. A set of argument schemes for reasoning with evidence, based on several common schemes, was presented in [13]. We will now say some more about the reasoning involved at each of the other stages.

2.1   From Issues to Outcome

Because they are the base level terms in a set of definitions, issues generally can be viewed as supplying necessary and sufficient conditions. We illustrate this point with reference to US Trade Secrets Law, which has been widely studied in AI and Law (e.g. [30], [2], [15], [16], [27], [7], [25]), and which we will use for our examples in this paper. Cases falling within this domain cover scenarios where there is a claim that a trade secret has been misappropriated, thus the
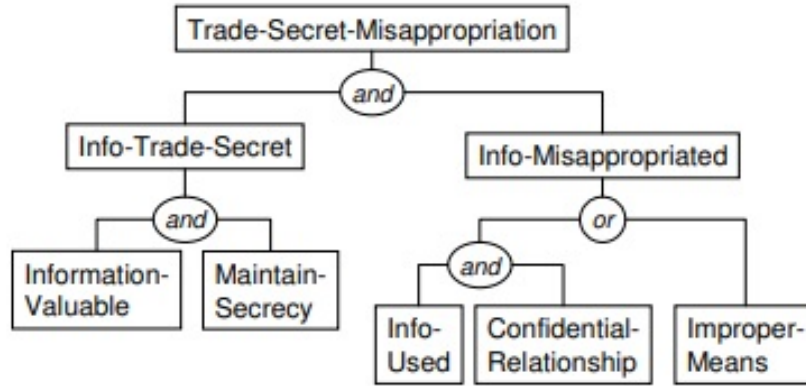
Figure 1: Issues in Us Trade Secrets Law [15]

information being considered in a case must be both a *Trade Secret* and have been *misappropriated*. These terms may be further defined: for information to be a Trade Secret it must be both *valuable* and its *secrecy maintained*. For information to be misappropriated it must have been *used* despite a *confidential relationship*, or obtained through *improper means*. Thus the issues can be expressed as what is termed a "logical model" in [15], as shown in Figure 1.

Once each of the leaf issues is resolved, the outcome can be determined.

2.2 From Factors to Issues

The resolution of the issues, however, tends to be less clear cut. Typically there will be reasons both why the issue should be resolved one way and why it should be resolved the other way. For example, with respect to the existence of a *confidential relationship*, a person may have disclosed the information in negotiations, which is a reason to find for the defendant, but the defendant may have been made aware that the disclosure was in confidence, which is a reason to find for the plaintiff, even if there was no formal agreement. Each issue will thus be associated with a set of factors, providing reasons to resolve the issue either for the plaintiff or the defendant. The factors associated with the issues in US Trade Secrets in [3] are shown in Table 1

These *factors* must be balanced against one another. Which set of reasons is considered stronger will depend on the preferences of the person making the choice: some will require a formal agreement, while others will not. In law these preferences are revealed in the past decisions, and courts are bound by these precedents[1]. Where no precedent exists, the judges must express a

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[1]For example, National Instrument Labs, Inc. v. Hycel, Inc., 478 F.Supp. 1179 (D.Del.1979) provides a precedent in favour of the existence of a confidential relationship where there had been *DisclosureInNegotiations* (F1d), but the defendant *KnewInfoConfiden-*

Table 1: CATO factors grouped by Issues [3]

Issue	Plaintiff Factors	Defendant Factors
InfoValuable	F8p Competitive Advantage F15p Unique Product	F16d Info Reverse Engineerable F20d Info Known to Competitors F24d Info Obtainable Elsewhere F27d Disclosure In Public Forum
SecrecyMaintained	F4p Agreed Not To Disclose F6p Security Measures F12p Outsider Disclosures Restricted	F10d Secrets Disclosed Outsiders F19d No Security Measures
ImproperMeans	F2p Bribe Employee F7p Brought Tools F14p Restricted Materials Used F22p Invasive Techniques F26p Deception	F17d Info Independently Generated F25d Info Reverse Engineered
InfoUsed	F7p Brought Tools F8p Competitive Advantage F14p Restricted Materials Used F18p Identical Products	F17d Info Independently Generated F25d Info Reverse Engineered
ConfidentialRelationship	F4p Agreed Not To Disclose F13p Noncompetition Agreement F21p Knew Info Confidential	F1d Disclosure In Negotiations F23d Waiver of Confidentiality

preference, creating a precedent that will govern future cases. Many questions arise concerning the construction of preferences in general [22], but in AI and Law the ideas of [12], [11] and [18] have generally been followed and it is taken that the preference will be according the purpose or social value promoted by the decision. This may involve argument as to which value should be preferred: this is modelled in [9]. We will not, however, discuss the question further in this paper: our discussion will be in terms of settled law, where precedents are available to resolve such preference questions.

The reasoning at this stage thus involves, for each issue, identifying the relevant factors for and against, and then, in the case of factors for both sides, choosing the stronger set, in accordance with precedents. Formal accounts of this style of reasoning with precedents are given in [19] and [25], and a set of argument schemes modelling it is given in [27]. These formal accounts are at the whole case level, but can readily be adapted to consider issues rather than complete cases [7].

2.3   From Facts To Factors

What factors are present in a given situation will depend on the facts. But the presence of a factor is not straightforwardly determined by the facts. For example, the security measures taken by the plaintiff will be relevant, but whether they are considered *adequate*, and so a reason to find that secrecy had been maintained and that factor F6p applies, or *inadequate*, and so F19d, a reason to decide that it had not, applies, will depend on what is considered reasonable, and the strictness of the standard applied. Thus the various relevant facts must be assessed for their significance for the decision maker, and this significance recorded by ascribing the appropriate factor to the case. Where the line is drawn will require a judgement. In common law, precedents will determine these "switching points" [28].

The ascription of factors has received rather less attention in AI and Law

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tial (F21p).

than the other stages. In [8] four different ways of ascribing factors were described: these will be discussed below in Section 6

2.4   Summary

Different AI and Law approaches have covered different stages in this process, as shown in Table 2. Thus [32] models only the legislation (of the British Nationality Act), and does not represent the interpretation of terms in the legislation through case law. In HYPO the dimensions are neutral and the user must decided which party they favour. In CATO the party favoured on a dimension is identified through the use of factors, but the user must decide which side is favoured on the balance of these factors. IBP can predict an outcome by using a logical model of issues once the issues have been resolved on the balance of factors. The focus of Bex *et al.'s* hybrid apprroach [14] is on the move from evidence to facts.

Table 2: Layers of Statements in a Legal Decision and Some Example Systems

Statement Type	BNA [32]	HYPO [30]	CATO [1]	IBP [15]	Bex [14]
Outcome	X			X	
Issues	X		X	X	
Factors		X	X	X	
Facts		X			X
Evidence					X

In this paper we will model the three stages after the facts have been agreed, using argumentation schemes and their critical questions [38].

3   Using Argumentation Schemes to Model Reasoning

Argument schemes are typically seen as a form of defeasible inference rules, but as argued in [24] they can also be used to model a reasoning process, by articulating the arguments that can be used and the objections that can be made at each stage of the process. Such sets of argument schemes can be used as the specification of dialogue system to realise this process (e.g. [4]). Here we will use argument schemes to describe the process of reasoning with legal cases.

To present reasoning with legal cases as an argument, a form of three ply argumentation was introduced in HYPO [30]. First a claim is made by a proponent, then the opponent challenges the claim, and finally the proponent tries to rebut these challenges. A repertoire of moves for each of these stages was developed [1]. This structure fits well with the notion of argumentation schemes as proposed by Walton [36]. Here an instantiated scheme is put forward, challenges made in the form of critical questions, and then the proponent attempts

to provide answers to these questions. This correspondence allows the argument moves of the original systems to be seen as argumentation schemes. Argumentation schemes provide an excellent way of making a reasoning procedure more precise, and indicating the ways in which assertions within that procedure may be challenged.

In this paper we will describe the three stages of the reasoning with legal cases identified above as argumentation schemes.

4   Determining the Outcome

Once resolved, issues can form the leaves of a logical model as depicted in Figure 1. This can then be seen as a standard example of logical reasoning, using the law represented as a set of rules. We can express the schemes thus:

Issue to Outcome Scheme (IO):
Warrant Premise: The law yields a rule R: $I_1, I_2...I_n \to O$
Issue Premise: $I_1, I_2...I_n$ are (not) satisfied
Conclusion: Outcome is (not) O

Examples in US Trade Secrets are ;

Example1
The law yields a rule that if the information is Trade Secret and Misappropriated the plaintiff should win

The information is Trade Secret and Misappropriated

Therefore, The plaintiff should win

Example2
The law yields a rule that if the information was Used and There is a Confidential Relationship and the information was Misappropriated the plaintiff should win

The information was not Misappropriated

Therefore, The defendant should win

Because these are strict rules, critical questions must take the form of questioning the premises.

IOCQ1: *Exception*: Is there an issue I_{n+1} which is satisfied and which provides an exception to R? (Where the argument is for O)

IOCQ2: *Unneeded Premise*: Is there an issue I_n :which is not required for O? (Where the argument is for not O)

IOCQ3: *Issue Incorrectly Resolved*: Is there an issue I_n which is in fact (not) satisfied?

We could thus pose the following critical questions in Example1:

IOCQ1Ex1: That the employee was the sole developer of the information provides an exception to the rule.

IOCQ3Ex1: The information was not, in fact, misappropriated.

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and we can object to Example2 with IOCQ2:

IOCQ2Ex2: It is not necessary that the information be *Misappropriated* where the information was *Used* and there is a *Confidential Relationship*.

5 Resolving the Issues

As described in [21], after an initial period of flux sufficient precedents are established for an area of law to be considered settled, until some events bring about a period of reinterpretation. Thus for much of the time, precedents will be available to decide questions of preference between factors: except for newly enacted legislation, landmark cases setting new precedents are relatively rare.

5.1 Resolving Issues With Precedents

A set of schemes to balance factors within a case in accordance with a set of precedents was proposed in [27]. These, however, ignored the intermediate stage of issues, and moved straight from factors to decisions. The schemes can, however, be easily adapted to resolve issues by considering not the complete set of factors but only those pertaining to the issue under consideration. It is generally straightforward to allocate factors to issues, as shown in Table 1. Thus in the following F_p and F_d should be taken to comprise only factors relevant to the issue I.

Citation Scheme (C): *Factor Premise*: Case C has plaintiff factors F_p and defendant factors F_d in common with precedent P
Precedent Premise: Issue I was resolved for the plaintiff (defendant) in P
Conclusion: Issue I should be resolved for the plaintiff (defendant) in C

For an example from US Trade Secrets we will consider resolution of the issue of *Secerecy Maintained*.

Example3
Among the factors associated with Secrecy Maintained are the plaintiff factors *SecurityMeasures* (F6p) and *OutsiderDisclosuresRestricted* (F12p) and the defendant factor *DisclosuresToOutsiders* (F10d). Suppose we have a case, *Restricted*, in which all three of these factors are present. We have a precedent, *Bryce*[2], in which *SecurityMeasures* was present and the other two factors were absent, and the issue was resolved for the plaintiff. On the basis of *Bryce* we can argue:

Restricted has factor *SecurityMeasures* in common with *Bryce*.
The issue *Secrecy Maintained* was resolved for the plaintiff in *Bryce*.

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[2]M. Bryce & Associates, Inc. v. Gladstone, 107 Wis.2d 241, 319 N.W.2d 907 (Wis.App.1982)

Therefore, the issue *Secrecy Maintained* was resolved for the plaintiff in *Restricted*.

Two critical questions may be posed against this scheme, either pointing to a counterexample, a precedent in which the issue was resolved differently, or by pointing to another factor present only in the case or the precedent which weakens the argument.

CCQ1: *Counterexample*: Is there another precedent P' with factors in common with C in which the issues was resolved for the defendant (plaintiff)?

CCQ2: *Distinction*: Is there a factor present in only the case or the precedent which weakens the case for the plaintiff (defendant)?

These two critical questions are found in [27]. But that paper takes the factors present in a case as given. If the presence of a factor can be disputed we get two more critical questions:

CCQ3: *Factor Not Present*: Is one of the factors f not in fact present in the case?

If the conclusion of the critiqued argument is to resolve the issue for the plaintiff, $f \in F_p$, and if to resolve for the defendant, $f \in F_d$.

CCQ4: *Additional Factor*: Is there an additional weakening factor f' present in the new case?

If the conclusion of the critiqued argument if to resolve the issue for the plaintiff, f' favours the defendant, and if to resolve for the defendant, f favours the plaintiff.

Counterexamples to pose CCQ1 are put forward using the Citation Scheme. Distinctions to pose CCQ2 are put forward using their own argument scheme.

Distinction Scheme (D):
Factor Premise A: There is a factor F present in only one of the current case C and Precedent case P
Polarity Premise: F weakens the case for the plaintiff (defendant)
Conclusion: Do not resolve Issue I for the plaintiff(defendant)

The polarity premise is needed because it is possible that the difference will strengthen rather than weaken a case. What is required (when attacking an argument for the plaintiff) is a pro-defendant factor in the current case but not the precedent, or a pro-plaintiff factor in the precedent but not the current case.

Example3 continued
Restricted has an additional defendant factor, *DisclosuresToOutsiders*, and this can be used to distinguish *Bryce*:

DisclosuresToOutsiders is present in *Restricted* but not in *Bryce*
DisclosuresToOutsiders weakens the case for the plaintiff

Therefore, Do not resolve Issue I for the plaintiff.

Critical questions can, of course, now be posed against the distinction scheme. These are based on the notion of downplaying a distinction developed in [1]. The idea is there may be some other factor present in only one of the cases which strengthens the case for the original party. Such a factor may be used to substitute for a missing factor (if the party favoured is the same), or cancel out an additional factor (if the party favoured is different).

DCQ1: *Substitution*: Is there a Factor F' which can substitute for F?

DCQ2; *Cancellation*: Is there a Factor F' which can be used to cancel F?

Example3 continued

In the case of *Restricted* we do have a factor which can cancel out the additional factor *DisclosuresToOutsiders*, namely *OutsiderDisclosuresRestricted*, so we can pose DCQ2.

Whether the factor is considered sufficiently strong to cancel out the distinguishing factor is something that must be decided by the court. If it were considered that it was strong enough, it would still be possible to pose CCQ3 by asking whether the security measures taken in *Restricted* were indeed adequate.

5.2 Where Precedents are not Needed

The above schemes do rely on the existence of precedents to determine the preference for the factors associated with one side rather than the other. Because, as can be seen from Table 1, there is only a relatively small number of factors associated with each issue, only a few leading cases will be needed to supply the necessary preferences. It should, however, be noted that in some cases the preference will be obvious from the nature of the factors; for example if the plaintiff has given a *WaiverOfConfindentiality* (F23d), then the issue will be resolved for the defendant, even if there had been an agreement not to disclose (F4p), or even a formal non-disclosure agreement (F13p). Such factors were termed *knockout* factors in [15].

For such factors we can have another scheme:

Knockout Factor Scheme (KO)

Factor Premise: Factor F, relating to issue I, is present in Case C

Knockout Premise: Factor F favours plaintiff (defendant) and is, by its nature, preferred to any factors favouring the defendant (plaintiff)

Conclusion: Issue I should be found for the plaintiff (defendant)

Critical questions can concern either whether the factor is present (to be resolved using the schemes for factor ascription presented in the next section), or whether it is indeed decisive (by citing a counterexample).

KOCQ1: Is factor F really present in C?

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KOCQ2: Is there a precedent case P containing factor F in which issue I was resolved for the defendant (plaintiff)?

5.3 Cases which Require a Preference

If we have an issue which cannot be resolved using either a precedent or a knockout factor, then the judges must themselves express a preference between the pro-plaintiff and pro-defendant factors. As discussed in [12] and [11], this will involve expressing a preference for the values promoted by finding for the plaintiff or those promoted by finding for the defendant. Such arguments are likely to be very varied, including such things as an appeal to established values in society ("life is more important than property"), feasibility ("where this to be decided, the floodgates for acrimonious litigation would be opened"), analogy with a different area of law ("this preference is established in contract law and should apply here also") or the constitutional remit of judges ("such a decision can only be made by the legislature"). The computational deployment of such arguments was discussed in [9]. The schemes used for such arguments are, however, not specifically legal, and may use a variety of the established schemes to be found in [36]. We will therefore not discuss them further here, but limit our discussion to areas of law sufficiently settled that the required precedents are available.

6 Ascribing the Factors

6.1 Dimensions and Factors

We now come to the ascription of factors. Factors were a development from dimensions in HYPO. In HYPO dimensions were aspects of cases which were potentially relevant to the outcome. In general, dimensions were a range of values which increasingly favoured one of the parties. Thus the number of disclosures was one such dimension, and the more disclosures, the more favourable the dimension was to the defendant. A small number of disclosures might be considered not to constitute a reason to find for the defendant, but at some point the number of disclosures would be sufficient. If a particular case falls in the range where the defendant is favoured, this means that the pro-defendant factor *DisclosuresToOutsiders* applies, but fewer disclosures means that no factor applies on this dimension. The point at which the factor starts to apply was termed the switching point in [29]. Most dimensions are either neutral or favour a particular side. Some, however, such as *SecurityMeasures*, favour the plaintiff at one end and the defendant at the other, giving rise to both a pro-plaintiff and a pro-defendant factors, possibly with a neutral range between them. Other dimensions, such as disclosures give rise to two factor for the same side: if the disclosure is in the public domain the stronger pro-defendant factor *DisclosureInPublicForum* applies rather than the normal *DisclosuresToOutsiders*.
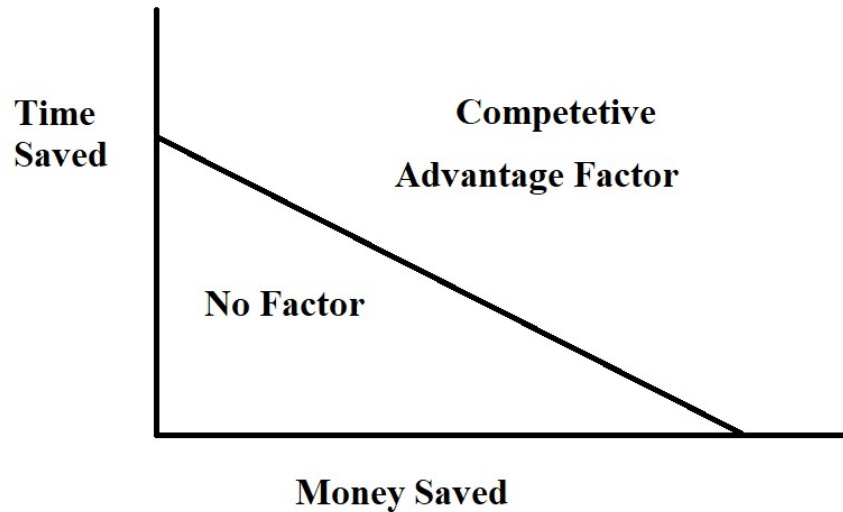
Figure 2: Competitive Advantage Factor

However, in HYPO many of the dimensions (10 out of the 13) were, in fact Boolean. Here one of the values would give rise to a factor: thus it is either true or false that the information was disclosed to the defendant in the course of negotiations, and if true then the pro-defendant factor *DisclosureInNegotiations* applies.

Finally we have a factor which arises from two dimensions: use of a trade secret may save the defendant time, money or both. If these savings are significant, then the factor pro-plaintiff *CompetiveAdvantage* (F8p) will apply. The significance will require consideration of both time and money: the more time saved, the less money need be saved and vice versa. Thus we get a trade off of the sort shown in Figure 2

These different relationships between factors and their dimensions mean that there are several ways in which factors are ascribed.

- For Boolean factors, factors may be ascribed on the basis of facts supplying necessary and sufficient conditions (i.e. the factor can be interpreted using its ordinary meaning);

- Also Boolean factors which may be ascribed according to analogy (for example employing a former employee of a competitor at well over the market rate in order to obtain information acquired in the former employment may be considered analogous to bribery).

- Factors ascribed according to whether some threshold (switching point) is passed (as in the case of disclosures);

- Factors which involve a trade off between two facts (such as time saved and money saved);

Each of these will have their own associated argument scheme.

6.2 Ordinary Meaning Scheme

The most straightforward scheme is where the facts of the case justify the ascription of a factor, on a ordinary interpretation of the terms involved.

Ordinary Meaning Scheme

Facts Premise: Facts $a_1...a_n$ are true in Case C_1

Usage Premise: As F is ordinarily understood, $a_1...a_n$ are sufficient for Factor F to be considered present in C_1

Conclusion: F is present in C_1

The following is a set of critical questions to enable the scheme's components to be questioned:

MCQ1: Does $a_1...a_n$ really justify the ascription of F? There might be some additional fact which is needed. For example we might require specific mention of the allegedly misappropriated information in a non-disclosure agreement.

MCQ2: Does some other fact, b, provide an exception which prevents the ascription of F? There might be some unusual feature in the situation which should prevent ascription. For example, although the information was disclosed in negotiations, the defendant entered the negotiations under false pretences.

MCQ3: Do other facts $b_1...b_n$ justify the ascription of factor F_2, which is incompatible with F? For example if the defendant had used restricted materials when developing his project, that should not be considered an example of reverse engineering, and so *ResatrictedMaterialsUsed* (F14p) should apply and *ReverseEngineered* (F25d) should not.

6.3 Analogy Scheme

There are a number of schemes for analogy in the literature. Different schemes are given in [38], [37] and [34]. Here we give one tailored to our need to analogise between aspects of cases rather than cases as a whole.

Analogy Scheme

Base Premise: A situation S_1 is described in precedent P_1.

Derived Premise: Factor F is plausibly ascribed to P_1 on the basis of S_1.

Case Premise: Case C_1 contains situation S_2

Similarity Premise: As it relates to F, situation S_2 is similar to situation S_1.

Conclusion: Factor F is plausibly ascribed to C_1.

Example4

In *Space Aero*[3], the defendant had acquired the information while an employee of the plaintiff and the issue of Confidential Relationship was resolved for the plaintiff, on the basis of the factor *KnewInfoConfdential* (F21p). Suppose in a new case, *Subcontract*, the defendant had acquired the information while an employee of a subcontractor working for the plaintiff.

We can now suggest an analogy between the two cases:

In *Space Aero*, the information was acquired while an employee of the plaintiff

KnewInfoConfdential was ascribed to *Space Aero* on this basis

As it relates to *KnewInfoConfdential*, being an employee of a subcontractor of the plaintiff is similar to being an employee of the plaintiff

KnewInfoConfdential is plausibly ascribed to *Subcontract*

The following set of critical questions is based on the account given in [38] for the basic scheme for argument from analogy.

ACQ1: Are there respects in which P_1 and C_1 are different that would tend to undermine the force of the similarity with respect to F? For example, a sub-contractor has a transient relationship, whereas an employee is in a more stable relationship.

ACQ2: Is the similarity sufficient for F to be ascribed? Employees of a sub-contractor have no direct relationship to the owner of the information.

ACQ3: Is there some other precedent P_2 that is also similar to C_1, but in which F was not ascribed? Suppose there was a precedent with a fixed term employee, where the relationship was not considered sufficient to ascribe *KnewInfoConfidential*.

6.4 Switching Point Scheme

The next scheme is based on Rigoni's notion of a *switching point* [29]. If we consider a dimension with a factor favouring the plaintiff at one end and a factor favouring the defendant at the other, there will be points (possibly the same) at which one factor ceases to apply and the other factor begins to apply. These are the *switching points*. Thus given a precedent more favourable on the dimension than the new case, we can say that the factor applies to the new case. Similarly, if the new case is less favourable, we can argue that the factor does not apply. We can use this notion as the basis of an argumentation scheme:

Switching Point Scheme

Precedent Premise: P_1 is a precedent with location L_1 on dimension D at which factor F is present.

Case Premise: C_1 is a case with L_2 on dimension D

Party Premise: F favours the plaintiff (defendant)

Value Premise: L_2 is more (less) favourable to the plaintiff (defendant) than L_1

Conclusion: F applies (does not apply) to C_1

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[3]Space Aero Products Co. v. R.E. Darling Co., 238 Md. 93, 208 A.2d 74 (1965).

Example5

In *National Rejectors*[4] engineering drawings were sent to customers and prospective bidders without limitations on their use. There were perhaps 100 such recipients and it was held that the factor *DisclosuresToOutsiders* applied. Suppose we have a new case, *Leaky*, in which there had been a similar practice with 150 recipients. We can say for the argument:

National Rejectors is a case with 100 disclosures and *DisclosuresToOutsiders* is present

Leaky is a case with 150 disclosures

DisclosuresToOutsiders favours the defendant

150 is more favourable to the defendant than 100

DisclosuresToOutsiders applies to *Leaky*

We can question an instantiation of this scheme with the following critical questions:

SCQ1: *Is L_2 so much more favorable that a different factor applies?* For example in the US Trade Secret domain of [1] there are two pro-defendant factors on the disclosures dimension, *DisclosedToOutsiders* and the stronger *DisclosedInPublicForum*.

SCQ2: When arguing that the factor does not apply because L_2 is less favourable: *Is L_2 sufficiently close to L_1 that the same factor applies?* It is possible that P_1 does not precisely identify the switching point, and that C_1 may become a new precedent for the factor, giving a more generous switching point. For example, had there been only 90 disclosures in a new case *LessLeaky*, it could still be that *DisclosedToOutsiders* applied.

SCQ3: *Is there another precedent, P2, which can ground an instantiation of the switching point scheme to give an argument that the factor does not (does) apply?*. It may be that some additional information is needed to say which precedent should apply. Suppose there were a case with 200 disclosures where *DisclosedToOutsiders* was held not to apply. Further examination of this case and *National Rejectors* would be needed to explain this different treatment, and the explanation applied to *Leaky*.

6.5 Trade Off Scheme

The next scheme concerns trade-offs between two dimensions, as described in [6]. For example in the US Fourth Amendment domain there is a trade-off between being able to enforce the law and respect for privacy [10]. The factor involves balancing these two concerns and is something like "Sufficient respect for privacy while enabling enforcement". The idea in [6] is that a line, e.g $a.D_1 + b.D_2 + c = 0$, can be fitted to the precedents[5], separating the pro-plaintiff and pro-defendant regions of the case space. In the equation a and b are the coefficients of the variables D_1 and D_2, representing the values on the

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[4]National Rejectors, Inc., v. Trieman, 409 S.W.2d 1 (Mo.1966).

[5]Of course more complicated curves can be used, but a straight line is the simplest.

two dimensions. This determines the gradient of the line which indicates how much more D_1 is need to compensate for less D_2, and c is a constant showing where the line crosses the axes given these coefficients.

Trade Off Scheme

Precedents Premise: $P_1...P_n$ are precedent cases in which factor F is present.

Locations Premise: Precedent $P_i \in \{P_1.., P_n\}$ have locations D_{1_i} and D_{2_i} for dimensions $D1$ and $D2$,

Case Premise: C_1 is a case with L_1 on dimension D_1 and L_2 on dimension D_2

Line Premise: All $a.D_{1_i} + b.D_{2_i} + c \geq 0$

Point Premise: $a.L_1 + b.L_2 + c \geq (<)\ 0$

Conclusion: F applies (does not apply) to C_1

Example6 Suppose we have two precedents to which *CompetitiveAdvantage* applied. In one (*Slow*) 8 months and \$500,000 was saved, and in the other (*Fast*) 24 months were saved, but only \$100,000. A line passing through these two points is $4(money) + 1(time) - 28 = 0$. Suppose we have a new case, *Useful*, in which \$300,000 and 20 months were saved. We can form the argument

Slow and *Fast* are precedent cases in which *CompetitiveAdvantage* is present

Slow and *Fast* have locations (5,8) and (1,24) on the money and time dimensions.

Useful has location 3 on the money dimension and 18 on the time dimension

For both *Slow* and *Fast* $4(money) + 1(time) - 28 = 0$

12 + 18 - 28 = 2, which is greater than 0

Therefore, *CompetitiveAdvantage* is present in *Useful*

Now suppose we have a precedent, *Useless*, in which \$300,000 was saved but only 14 months. Now 12 + 14 - 28 = -2, and so we can argue that *CompetitiveAdvantage* is not present in *Useless*.

For this scheme we have the following key critical questions;

TCQ1: Is there a counter example, a precedent, P_{n+1}, for which $a.D_{1_{n+1}} + b.D_{2_{n+1}} + c < (\geq)\ 0$?. There might be a precedent which does not fit the line. For example if we had a precedent which saved \$400,000 and 13 months in which *CompetitiveAdvantage* was held to be absent. This would suggest that we need a more complicated curve than the simple line used in the argument, and it is possible *Useful* would fall on the wrong side.

TCQ2: Can the line be drawn less (more) tightly? If the precedents are not precisely on the line the constant c could be adjusted to raise (lower) the line to allow (disallow) more cases to qualify unless this created a counter example. For example, if we lower the line by reducing the constant c to 26, then *Useless* will fit and *CompetitiveAdvantage* can also be ascribed to this case.

7 Discussion

The schemes presented here are derived from reasoning with legal cases in which precedents are available to resolve the issues that arise and the ascription of factors. Some of the procedures can be adapted to practical reasoning in less formal circumstances. For example, when choosing a restaurant [5], we can identify issues such as value for money, convenience and quality of experience. Each of these will have associated factors: value will depend on cost and quality, convenience on distance and speed of service, and the quality of experience on the nature of the cuisine and the noise level and so on. Whether these dimensions will give reasons to choose or reject a venue will be a matter of judgement: a restaurant may not be expensive enough that that is a reason to avoid it, nor cheap enough that it is a reason to select it. Thus far, the problem is similar to the legal situation, in that it can be decomposed into the same elements. Some schemes may also be applicable: once the issues have been resolved, we can probably apply a rule: for example that the venue is at least satisfactory on each issue. Identifying reasons for and against also involves the move from points on relevant dimensions to reasons for or against, and this to could make use of the schemes in Section 6. This big difference lies in the way competing arguments are resolved. In law it is desirable that like cases are treated in a like manner, but this is not so with decisions like choosing a restaurant: in fact variety may be a reason for acting differently from the last time. In such discussions it is important that the preferences accepted by the group be established[6], but this has to be done other than by appeal to precedent. This need to establish preferences other than by using precedents limits the applicability of these legal schemes to practical reasoning tasks.

Classification tasks are, however, a different matter. The style of explanation given by the above schemes have been used in [26] to explain the outputs from machine learning systems for a variety of non legal domains: customer churn, poisonous mushrooms and university admissions. In such domains it is possible to treat the known cases as precedents, and to explain a classification in terms of similarity of features. If I know one red mushroom with white spots is poisonous, this may well explain why I think a new red mushroom with white spots is also poisonous. Note that in such a domain there are no preferences: the relationship between features and classification is assumed to be a matter of causal *fact*, not personal *choice*, as in the case of practical reasoning tasks. The *direction of fit* [31] is crucial: for classification we must fit our beliefs to the world, whereas in practical reasoning we attempt to make the world fit our desires.

Thus it may be possible to use these schemes in domains outside law, but this will require that the reasoning does not require preferences, as with classification, or that these preferences can be established by some means.

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[6]This point applies more generally within deliberation dialogues, as demonstrated through the model provided in [20].

8   Concluding Remarks

In this paper we have modelled reasoning with legal cases as a set of argument schemes, with different schemes relevant to the different stages of the process. These scheme will in particular support the presentation of justifications for and explanations of the reasoning in such cases. By presenting instantiations of the schemes and allowing the user to pose critical questions it is possible to tailor the explanations to the needs of particular user, and provide contrastive explanations [23] by explaining why things do not hold as well as why they do.

References

[1] Vincent Aleven. *Teaching case-based argumentation through a model and examples.* PhD thesis, University of Pittsburgh, 1997.

[2] Kevin Ashley. *Modeling legal arguments: Reasoning with cases and hypotheticals.* MIT press, Cambridge, Mass., 1990.

[3] Kevin Ashley and Stefanie Brüninghaus. Automatically classifying case texts and predicting outcomes. *AI and Law*, 17(2):125–165, 2009.

[4] Katie Atkinson, Trevor Bench-Capon, and Peter McBurney. A dialogue game protocol for multi-agent argument over proposals for action. *Autonomous Agents and Multi-Agent Systems*, 11(2):153–171, 2005.

[5] Katie Atkinson, Trevor Bench-Capon, and Douglas Walton. Distinctive features of persuasion and deliberation dialogues. *Argument and Computation*, 4(2):105–127, 2013.

[6] Trevor Bench-Capon. Using issues to explain legal decisions. In *Proceedings of XAILA 2021*. arXiv preprint arXiv:2106.14688, 2021.

[7] Trevor Bench-Capon and Katie Atkinson. Precedential constraint: The role of issues. In *Proceedings of the 18th ICAIL*, pages 12–21, 2021.

[8] Trevor Bench-Capon and Katie Atkinson. Argument schemes for factor ascription. In *Proceedings of COMMA 2022*. In Press, 2022.

[9] Trevor Bench-Capon and Sanjay Modgil. Case law in extended argumentation frameworks. In *Proceedings of the 12th ICAIL*, pages 118–127, 2009.

[10] Trevor Bench-Capon and Henry Prakken. Using argument schemes for hypothetical reasoning in law. *AI and Law*, 18(2):153–174, 2010.

[11] Trevor Bench-Capon and Giovanni Sartor. A model of legal reasoning with cases incorporating theories and values. *Artificial Intelligence*, 150(1-2):97–143, 2003.

[12] Donald Berman and Carole Hafner. Representing teleological structure in case-based legal reasoning: The missing link. In *Proceedings of the 4th ICAIL*, pages 50–59, 1993.

[13] Floris Bex, Henry Prakken, Chris Reed, and Douglas Walton. Towards a formal account of reasoning about evidence: argumentation schemes and generalisations. *AI and Law*, 11(2):125–165, 2003.

[14] Floris Bex, Peter Van Koppen, Henry Prakken, and Bart Verheij. A hybrid formal theory of arguments, stories and criminal evidence. *AI and Law*, 18(2):123–152, 2010.

[15] Stephanie Brüninghaus and Kevin Ashley. Predicting outcomes of case based legal arguments. In *Proceedings of the 9th ICAIL*, pages 233–242. ACM, 2003.

[16] Alison Chorley and Trevor Bench-Capon. An empirical investigation of reasoning with legal cases through theory construction and application. *AI and Law*, 13(3):323–371, 2005.

[17] Thomas Gordon and Nikos Karacapilidis. The Zeno argumentation framework. In *Proceedings of the 6th ICAIL*, pages 10–18, 1997.

[18] Matthias Grabmair. *Modeling Purposive Legal Argumentation and Case Outcome Prediction using Argument Schemes in the Value Judgment Formalism*. PhD thesis, University of Pittsburgh, 2016.

[19] John Horty and Trevor Bench-Capon. A factor-based definition of precedential constraint. *AI and Law*, 20(2):181–214, 2012.

[20] Yanko Kirchev, Katie Atkinson, and Trevor Bench-Capon. Demonstrating the distinctions between persuasion and deliberation dialogues. In *Proceedings of the 39th SGAI International Conference on AI*, pages 93–106, 2019.

[21] E Levi. An introduction to legal reasoning. *The University of Chicago Law Review*, 15(3):501–574, 1948.

[22] Sarah Lichtenstein and Paul Slovic. *The construction of preference*. Cambridge University Press, 2006.

[23] Tim Miller. Explanation in Artificial Intelligence: Insights from the social sciences. *Artificial intelligence*, 267:1–38, 2019.

[24] Henry Prakken. On the nature of argument schemes. *Dialectics, dialogue and argumentation. An examination of Douglas Walton's theories of reasoning and argument*, pages 167–185, 2010.

[25] Henry Prakken. A formal analysis of some factor-and precedent-based accounts of precedential constraint. *AI and Law*, 29(4):559–585, 2021.

[26] Henry Prakken and Rosa Ratsma. A top-level model of case-based argumentation for explanation: formalisation and experiments. *Argument and Computation*, 13(2):159–194, 2022.

[27] Henry Prakken, Adam Wyner, Trevor Bench-Capon, and Katie Atkinson. A formalization of argumentation schemes for legal case-based reasoning in ASPIC+. *Journal of Logic and Computation*, 25(5):1141–1166, 2015.

[28] Adam Rigoni. An improved factor based approach to precedential constraint. *AI and Law*, 23(2):133–160, 2015.

[29] Adam Rigoni. Representing dimensions within the reason model of precedent. *AI and Law*, 26(1):1–22, 2018.

[30] Edwina Rissland and Kevin Ashley. A case-based system for Trade Secrets law. In *Proceedings of the 1st ICAIL*, pages 60–66. ACM, 1987.

[31] John Searle. *Rationality in action*. MIT press, 2003.

[32] Marek Sergot, Fariba Sadri, Robert Kowalski, Frank Kriwaczek, Peter Hammond, and Terese Cory. The British Nationality Act as a logic program. *Communications of the ACM*, 29(5):370–386, 1986.

[33] Edwina Skalak, Davidand Rissland. Arguments and cases: An inevitable intertwining. *AI and Law*, 1(1):3–44, 1992.

[34] Katharina Stevens. Reasoning by precedent—between rules and analogies. *Legal Theory*, pages 1–39, 2018.

[35] Nina Varsava. How to realize the value of stare decisis: Options for following precedent. *Yale Journal of Law and the Humanities*, 30:62–120, 2018.

[36] Douglas Walton. *Argumentation schemes for presumptive reasoning*. Lawrence Erlbaum Associates, 1996.

[37] Douglas Walton. Similarity, precedent and argument from analogy. *AI and Law*, 18(3):217–246, 2010.

[38] Douglas Walton, Christopher Reed, and Fabrizio Macagno. *Argumentation schemes*. Cambridge University Press, 2008.