



# Modelling Legal Cases

Workshop co-located with the 12th International  
Conference on Artificial Intelligence and Law

**Editor:**

Katie Atkinson

Universitat Autònoma de Barcelona  
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Katie Atkinson (*Editor*)

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Legal Deposit:

*Editors' addresses:*

University of Liverpool,  
Department of Computer Science,  
Ashton Building,  
Ashton St,  
Liverpool,  
L69 3BX,  
UK  
Email: K.M.Atkinson@liverpool.ac.uk

Institute of Law and Technology  
Political Sciences and Public Law Department  
School of Law  
Universitat Autònoma de Barcelona  
08193 Bellaterra, Spain

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## Introduction to the Volume

Research in AI and Law has, throughout its history, produced a variety of approaches by which legal cases can be modelled. These approaches support different styles of reasoning for a variety of problem-solving contexts, such as decision-making, information retrieval, teaching, etc. Particular legal cases that have received wide coverage in the AI and Law literature include: the famous property law case of *Pierson v. Post* (see e.g. Berman and Hafner, 1993<sup>1</sup>; Gordon and Walton, 2006<sup>2</sup>); other cases involving the capture of wild animals such as *Young v. Hitchens* and *Keeble v. Hickeringill* (see e.g. Berman and Hafner, 1993; Bench-Capon and Rissland, 2001<sup>3</sup>); US trade secrets cases such as *Mason v. Jack Daniel Distillery* (see e.g. Aleven and Ashley, 1997<sup>4</sup>); and, criminal cases such as the Rijkbloem case (see e.g. Bex et. al, 2007<sup>5</sup>). In order to provide a forum for researchers to present and discuss their own particular approaches to modelling such legal cases, a workshop on this topic was held at the Twelfth International Conference on Artificial Intelligence and Law (ICAAIL '09) in June 2009 in Barcelona, Spain. This was the second edition of the workshop and the research papers presented, which appear in this volume, covered a wide variety of approaches to the topic. Seven papers were presented at the workshop (4 long papers, 1 short paper and 2 research abstracts). The approach to case representation used amongst the papers varies widely, and includes: ontology-based approaches; argumentation formalisms; hypothetical reasoning; and representation with factors and dimensions.

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1. D. H. Berman and C. L. Hafner (1993): Representing teleological structure in case based reasoning: the missing link. In: *Proceedings of the Fourth International Conference on Artificial Intelligence and Law (ICAAIL '93)*, pp 50–59.
  2. T. F. Gordon and D. N. Walton (2006): The Carneades argumentation framework—using pre-suppositions and exceptions to model critical questions. In: *Proceedings of the First International Conference on Computational Models of Argument (COMMA '06)*, pp 195–207. IOS Press, Amsterdam.
  3. T. J. M. Bench-Capon and E. L. Rissland (2001): Back to the future: Dimensions revisited. In: *Legal Knowledge and Information Systems (Jurix '01): The Fourteenth Annual Conference*, pp 41–52. IOS Press, Amsterdam.
  4. V. Aleven and K. D. Ashley (1997): Teaching casebased argumentation through a model and examples, empirical evaluation of an intelligent learning environment. In: *Proceedings of the Eighth World Conference of the Artificial Intelligence in Education Society*, pp 8794. IOS Press: Amsterdam.
  5. F. Bex, H. Prakken and B. Verheij (2007): Formalising argumentative story-based analysis of evidence. In: *Proceedings of the Eleventh International Conference on Artificial Intelligence and Law (ICAAIL '07)*, pp 1–10.

Thanks are due to all authors of papers, reviewers who provided feedback, audience participants, and the organisers of the IDT series –in particular Pompeu Casanovas– all of whom have helped to contribute to an interesting volume on this topic.

Katie Atkinson  
*University of Liverpool*

## Foreword to the Volume

Cases: The Lifeblood of the Law

It is with considerable pleasure that I write this introduction to the collected papers presented and discussed at the Modelling Legal Cases organised and chaired by Katie Atkinson and held on June 8<sup>th</sup> 2009 just before the International Conference on AI and Law in Barcelona.

Cases are the lifeblood of law, giving personality and interest to the dry bones of statute law. Particular cases have played an important role in AI and Law since the discipline began. The tax law case *Eisner v McComber* was used by Thorne McCarty in TAXMAN, one of the first important AI and Law projects. Edwina Rissland illustrated the hypothetical reasoning of the USA Supreme Court with *Carney v California* in 1989 and this case is still used to drive discussion of hypothetical reasoning today. Also important are the line of wild animals and property law cases beginning with *Pierson v Post* and introduced by Carole Hafner and the late Don Berman in 1983, and which remains an important focus for teleological arguments in Law, recently invigorated by the addition of *Popov v Hayashi*. A particular favourite of mine in *Mason v Jack Daniels*, used by Vincent Aleven and Kevin Ashley in CATO and which concerned a secret cocktail recipe and was the basis of an episode of *The Simpsons*, with Lychburg Lemonade transformed into the Flaming Moe. Classic cases such as these provide important benchmarks against which new solutions to old problems can be assessed.

Cases raise particular legal problems, often with colourful and interesting details that make the problems memorable. Representing cases is an important task for those working in AI and Law because it forces them to confront the messy realities of real life, and to accommodate these uncomfortable details in their theories. Without paying cases their due respect, we can develop elegant theories, but lack the connection with the problems that should motivate our research. The amount of detail, however, is often difficult to present in a conference paper, which makes workshops such as this so useful, since it gives time and space to discuss

The workshop provided an enjoyable and stimulating day for the participants with much discussion of the issues to be found in the papers in this volume. Particular thanks to Katie for making it happen.

Trevor Bench-Capon  
*University of Liverpool*



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# Evidential Reasoning about Motives: a Case Study

Floris Bex

University of Groningen  
Faculty of Law  
The Netherlands  
f.j.bex@rug.nl

Trevor Bench-Capon

University of Liverpool  
Department of Computer Science  
Liverpool L69 3BX, UK  
tbc@liverpool.ac.uk

Katie Atkinson

University of Liverpool  
Department of Computer Science  
Liverpool L69 3BX, UK  
katie@liverpool.ac.uk

**Abstract.** Motives play an important role at every stage of a criminal investigation. They can be used to search for an explanation of the crime (why was this person killed?), to identify a suspect (who would have killed this person for this reason), and to persuade a jury of a suspect's guilt (this motive explains why this person committed this crime). We have previously developed an account of motivations based on a general approach to practical reasoning. In this paper we will concentrate on the use of motives to provide plausibility to a story intended to persuade a jury of a person's guilt or innocence. We will concentrate on a particular case study, formalised previously by Thagard, the two trials of Claus von Bülow. An advantage of our approach is that it allows stories to be considered from an *intentional* as well as a *physical* stance, whereas in previous accounts, including Thagard's, only the physical stance is available. We show how our approach can be used to explain the outcome of both trials, and to identify the points in which the defence could be improved from the first trial to the second.

**Keywords.** Argumentation, Legal Evidence, Motives, Practical Reasoning, Values.

## 1. Introduction

Motives play an important role at every stage of a criminal case. They can be used to search for an explanation of the crime (why was this person killed?), to identify a suspect (who would have the motive to kill this person) or to persuade a jury of a suspect's guilt (this motive explains why the suspect committed the crime). In this paper we present a formal framework for the analysis of reasoning with such motives and their underlying values, concentrating on the use of motives to provide plausibility to a story intended to persuade a jury of a person's guilt or innocence.

A persuasive story should be plausible in that it conforms to our beliefs about how things generally happen in the world around us. This plausibility is partly dependent on the plausibility of the (physical) causal relations between the events in the story. For example, a story in which the victim ends up in a coma because she was injected with insulin is only plausible if we believe that an overdose of insulin can cause such a comatose state. The plausibility of a story is also dependent on how likely it is that the agents in the story would have made the alleged choice in the situation, and this in turn depends on the value preferences we believe an agent to have. For example, a story in which the suspect kills the victim in order to inherit the victim's money is only plausible if we believe that the suspect values money higher than the life of the victim. When determining the plausibility of a story we can thus differentiate between plausibility as regarded from the *physical* as well as the *intentional stance* [8].

Other work on evidential reasoning in AI and Law, most notably by Bex and colleagues [6] and Thagard [11], mainly focuses on reasoning from the physical stance. While both approaches allow for the inclusion of links that denote some sort of "motivational causation" (i.e. motive *causes* action), the reasoning about why a certain choice was made by the agents in a case remains implicit. Similarly, Walton and Schafer [13] establish the existence of a motive, but lack the machinery to explain why an actor chose to act on this motive in the particular situation.

Our current account of reasoning with motives and values, which is based on a general approach to practical reasoning, was previously introduced in [4]. In this work we discussed how explanations of what happened in a criminal case can be inferred through abductive reasoning, and how the possible motives of the agents can influence the choice between these explanations. In this paper we will forgo further discussion of abductive inference. Instead, we will mainly look at how motives and agents' value preferences can be used to persuasively argue for one particular story in a case where there are multiple accounts of the events.

In the current paper we will also provide a study of an actual legal case, namely the two trials of Claus von Bülow, who was accused of attempting to

murder his wife Sunny<sup>1</sup>. The case has been the subject of much discussion and even a Hollywood movie. It was previously formalised in AI and Law by Thagard [11], which allows us to actively compare our approach to Thagard's explanatory coherence theory.

In section 2 we will discuss the typical aspects of motives and values in a criminal legal context as far as relevant for this paper and in section 3 we recapitulate our approach to reasoning about motives. Section 4 will present the case study, and discuss the first trial in particular. Section 4 will show how our analysis can help to explain the different presentation of the defence case in the second trial, and why that presentation was successful. Section 5 will provide some discussion and concluding remarks.

## 2. Motives in evidential reasoning

When discussing reasoning about motives, it is useful to distinguish the separate concepts of *value*, *motive* and *goal*. Values, as defined by [3], can be seen as abstract principles which an agent or a group of agents hold. Examples of values are “wealth”, “love” and “honesty”. Agents can be expected to, actively or passively, promote the values which they find important. Our concept of motive is roughly the same as this concept of value, in that a motive is an abstract good which an agent may or may not want to promote. Such a motive can cause a person to form any number of goals in order to promote the principle for which the motive stands. For example, if Claus is motivated by his will to be independent from Sunny, he can plan to murder Sunny. However, he can also form the less drastic plan to simply divorce his wife. So the same motive can cause a person to form different goals. This current notion of motive and goal is somewhat different from [13], where the authors essentially equate an agent's motive with an immediate goal of the agent. In our opinion, our current notion of motive better captures the basic intuition that the same motive can be satisfied in different ways. In the rest of this paper, the terms *motive* and *value* will often be used interchangeably.

Motives and values play an important role in all stages of criminal investigation and decision making. De Poot *et al.* [7] divide cases into several categories, where each category corresponds to a particular phase in the process of criminal investigation and decision making. In a *search case*, there is no suspect and no scenario. An example is a case in which only physical evidence is found, for example a dead body. In such a case, possible scenarios should be constructed and compared; in the example, scenarios for accident, suicide and murder can be constructed. An alleged motive can play an important part in constructing these provisional scenarios. If, for example, the person that is

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<sup>1</sup> Although the alleged crime took place in 1980, the case attracted some renewed interest in late 2008 when the victim died after 28 years in a coma.

found dead is a wealthy heiress, one could do well by searching for scenarios that contain monetary motives on the part of the culprit. In an *investigation case*, the scenario is known but the suspect is not and it has to be investigated who could have been the main actor (i.e. the perpetrator) in the story about the crime. For example, this could involve looking for persons who would financially benefit from the heiress' death, that is, persons for whom the motivation of money is a real option. In a *verification case*, the scenario as well as the identity of the possible suspect is known and this identity needs to be verified by providing a suitable motive. For example, the victim's husband could be the kind of person who is motivated by monetary gain to kill his wife.

In all stages it is important to consider possible alternatives so as to avoid the well-known problem of confirmation bias or tunnel vision. One way of providing such an alternative is to tell a totally new story (with possibly a different suspect) that explains the evidence at least as well as the current story. Another way of providing an alternative is to argue that this particular suspect was not the perpetrator of the crime. Instead of providing a totally new explanation for the evidence, it is simply argued that the current suspect could not or would not commit such a crime, thus providing what we call a "suspect-specific" alternative. For example, it can be argued that it was not physically possible for the suspect to have committed the crime because he or she was somewhere else at the time, thus providing the suspect with an alibi. It can also be argued that the suspect is not the type of person who would commit such a crime by showing that his motivational preferences are different from those assumed; in the example, one could argue that the husband values the love for his wife higher than money so he would never kill her, even though he would benefit financially from her death. Finally, it can be argued that given the suspect's values, he could have satisfied his motives by acting differently. For example, it might be argued that it would have been easier for the suspect to divorce his wife and take half of her fortune with him.

These last two ways of providing a suspect-specific alternative are examples of reasoning about the suspect's motives and the suspect's willingness to act on such motives. This shows that in any (formal) reasoning framework which is used in evidential reasoning we should be able to rationalise why the suspect in a case chose to act on his motives in that particular situation.

Before we continue, one related notion, namely that of character, should be briefly discussed. In this paper, a person's character is modelled as an ordering of his or her motives. For example, we can say that Claus is the kind of person who prefers independence over honesty. If we have evidence that Claus is such a person — for example, that he has lied on previous occasions - we can provide an argument for this particular preference. As Walton and Schafer [13] note, character evidence is often inadmissible at trial. However, it may be admissible for the purpose of proving someone's motive, which is exactly the purpose we use it for.

### 3. Practical Reasoning with Motives

In [4], which has been extended and revised as [5], we attempted to analyse motives in terms of an agent choosing to act so as to promote some value by realising some goal, an approach to practical reasoning previously developed by Atkinson and her colleagues in [1], and [2]. The approach is based on the use of an argumentation scheme and critical questions which allow justifications for action to be presumptively proposed and critiqued. The original scheme defined by Atkinson et al. in [2], was as follows:

AS1 In the current circumstances R  
 We should perform action A  
 Which will result in new circumstances S  
 Which will realise goal G  
 Which will promote value V.

This argumentation scheme can be used by an agent to justify an action in particular circumstances in terms of his values. For a given instantiation of this scheme a number of critical questions could be posed, in order to challenge the various elements of the scheme and so dispute the presumptive conclusion. The sixteen listed in [2] were:

- CQ1: Are the believed circumstances true?
- CQ2: Assuming the circumstances, does the action have the stated consequences?
- CQ3: Assuming the circumstances and that the action has the stated consequences, will the action bring about the desired goal?
- CQ4: Does the goal realise the value stated?
- CQ5: Are there alternative ways of realising the same consequences?
- CQ6: Are there alternative ways of realising the same goal?
- CQ7: Are there alternative ways of promoting the same value?
- CQ8: Does doing the action have a side effect which demotes the value?
- CQ9: Does doing the action have a side effect which demotes some other value?
- CQ10: Does doing the action promote some other value?
- CQ11: Does doing the action preclude some other action which would promote some other value?
- CQ12: Are the circumstances as described possible?
- CQ13: Is the action possible?
- CQ14: Are the consequences as described possible?
- CQ15: Can the desired goal be realised?
- CQ16: Is the value indeed a legitimate value?
- CQ17: Will the other agent's prevent the stated consequences from being realised?

In order to provide a formal basis for this argumentation scheme, the problem scenario is modelled as an Action-based Alternating Transition System (AATS) [14]. Essentially, an AATS consists of a set of states and transitions between them representing the possible joint actions of the agents in a given state. These transitions are labelled with the values (motives) promoted by moving from the source state to the target state. In the AATS, the notion of a goal is identified with the new state, as, in our case study, it is assumed that all the features of the new state will be part of an agent’s goal. The argumentation scheme and all of its associated critical questions are given formal definitions in terms of an AATS in [2].

Arguments following the above scheme are now based on a particular path from the current state to a new state in the AATS. As an agent can only perform one action in the given circumstances, arguments for different actions attack each other. The critical questions also point to possible counterarguments: a negative answer to, for example, CQ13 attacks any argument for the particular action. Once a set of arguments and the attacks between them has been generated on the basis of a specific AATS, the status of the arguments can be evaluated. To do this we form the arguments into a Value Based Argumentation Framework (VAF), introduced in [3]. A VAF is an extension of the argumentation frameworks (AF) of Dung [9]. In an AF an argument is admissible with respect to a set of arguments  $S$  if all of its attackers are attacked by some argument in  $S$ , and no argument in  $S$  attacks an argument in  $S$ . In a VAF an argument succeeds in defeating an argument it attacks only if its value is ranked as high, or higher, than the value of the argument attacked. In VAFs audiences are characterised by their ordering of the values. Arguments in a VAF are admissible with respect to an audience  $A$  and a set of arguments  $S$  if they are admissible with respect to  $S$  in the AF which results from removing all the attacks which do not succeed with respect to the ordering on values associated with audience  $A$ . A maximal admissible set of a VAF is known as a Preferred Extension (PE).

One of the key elements that the above approach brings is the explicit distinction between arguments that can be made to reason about physical causal relations and arguments that can be made to reason about motivations and their priorities. The formal framework as described here allows us to predict what possible actions an agent would take given its values and an ordering on these values. This kind of reasoning is often employed in the verification stage, where it is argued that, given the circumstances, the suspect would have acted in a particular way to fulfill his or her motives. Since crimes are “by definition deviant behaviour, what people do not normally do” [13], the key to the plausibility of this argument is explaining why the accused acted in the aberrant fashion. While a typical agent would not have chosen the action using a “normal” value order, there is some value order on which it would be chosen: that the agent under suspicion in fact had this unusual ranking of values itself needs to be explained in order to make the agent’s choice of this action plausible. Consequently, when considered from the intentional stance, there are three elements to a plausible story:

1. a motive for the action,
2. an explanation of why the agent had this motive, and
3. an explanation of why the agent's value order was such as to make this motive of sufficient importance.

As we describe in the next section, there are numerous different states that the defendant Claus von Bülow could have been trying to reach, and could well be motivated to reach, each of which require consideration in coming to a decision about the case. The critical questions draw out distinctions that need to be considered concerning the motivational preferences of the defendant, and the alternatives available for satisfying those motives.

In [4], we extended the above non-abductive view on practical reasoning with a separate argument scheme for abductive practical reasoning to allow for search and investigation cases. This abductive scheme makes it possible to infer an explanation for a set of circumstances in terms of a motivated action. As with the original scheme, there are critical questions associated with the abductive scheme that allow the elements of the explanation to be critiqued. Additionally, new critical questions were formulated which provided ways of asking for alternative explanations for the circumstances. The abductive scheme can be combined with the normal scheme, which enables us to reason both predictively and explanatory about motivated actions. In [4] we provided an example that represented a scenario where a person was killed by toppling off a bridge and the question to be resolved was whether he jumped or was pushed. With the abductive scheme, several possible explanations for his fall were inferred and the normal scheme was then used to try to verify these explanations<sup>2</sup>. Formal definitions of the abductive argument scheme and its associated critical questions in terms of an AATS are given in [5].

In this paper, our focus is not on generating possible explanations, but rather to examine the plausibility of the contention that the defendant Claus von Bülow acted as alleged in the prosecution's story. Here, we will simply adopt Thagard's formulation of the story. Because the case can thus be considered a verification case, the reasoning will be mainly based on AS1 and its critical questions.

## 4. Case Study

We will use as our central case study the von Bülow case, formalised by Thagard in [11]. In 1980, Martha van Bülow, known as Sunny, a wealthy heiress and well-known socialite, went into a coma from which she eventually died in late 2008. In 1982 her husband, Claus von Bülow, was convicted of her attempted

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<sup>2</sup> Technically, we used did not use the full normal scheme in [4]. Rather, a critical question for the abductive scheme that represented the normal scheme in condensed form was used.

murder. In 1985 he was granted a new trial and acquitted<sup>3</sup>. Thagard presents the case as an exercise in causal reasoning, notionally undertaken by the jurors, stating that ‘legal reasoning in trials such as those of Claus von Bülow’s can be characterized as inference to the best overall causal story’. By *best*, Thagard means most coherent according to his basic principles of explanatory coherence, which are implemented in terms of a connectionist algorithm.

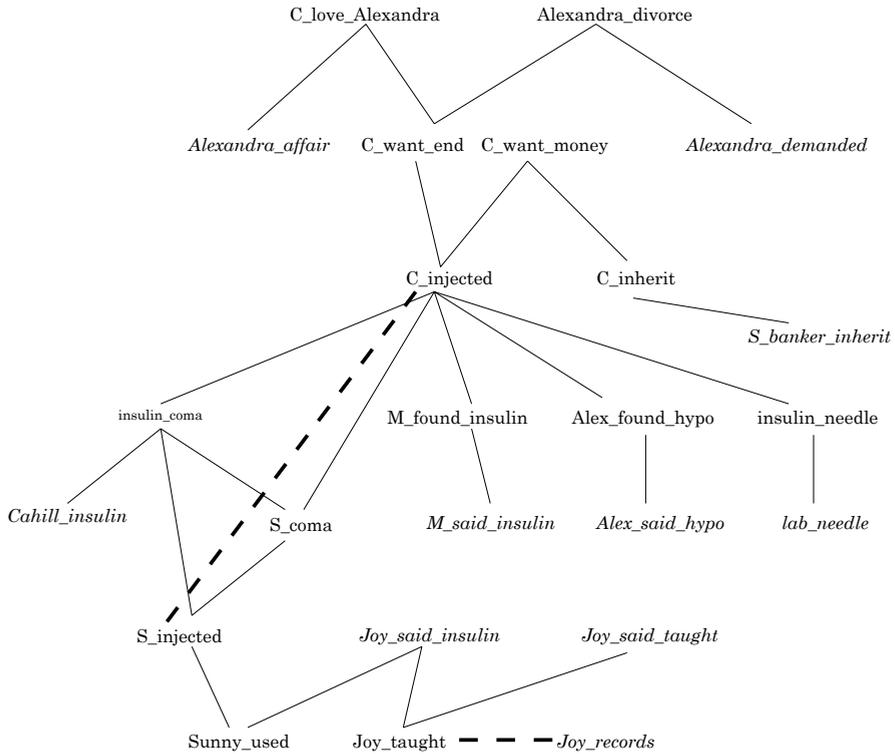
We shall use Thagard’s formalisation as the basis for our representation of the case. Thagard divides his propositions into evidence, prosecution hypotheses, and defence hypotheses. Propositions can relate to one another either by one proposition contradicting another, or by one proposition explaining another. His approach is to use these relations in a connectionist model to determine a degree of explanatory coherence, propositions explaining one another increasing coherence (*excitatory links*) and propositions contradicting one another decreasing coherence (*inhibitory links*).

#### 4.1. The First Trial

Figure 1 shows Thagard’s model of the first trial, where normal lines denote excitatory links and dotted lines denote inhibitory links. The evidence in the case was taken from a number of witnesses, as well as clearly observable facts. Thagard’s evidence is as follows. The short names in brackets are Thagard’s and used in Figure 1.

- *Observable Fact*: Sunny went into a coma (S-coma).
- *Testimony from Maria* (Sunny’s maid). Maria found insulin in Claus’s bag (Maria-said-insulin)
- *Testimony from Alex* (Sunny’s son by a previous marriage). Alex found a used hypodermic in Claus’s bag (Alex-said-hypo).
- *Testimony from Cahill* (presumably Sunny’s doctor). Insulin put Sunny in a coma (Cahill-insulin).
- *Testimony from Sunny’s Banker*: Claus would inherit \$14 million if Sunny died (S-banker-inherit).
- *Testimony from Alexandra* (Claus’s mistress). Alexandra was having an affair with Claus (Alexandra-affair) and she demanded that Claus get a divorce (Alexandra-demanded).
- *Testimony from Joy* (A personal trainer). Joy had taught Sunny many times (Joy-said-taught) and that Sunny had recommended insulin as a slimming aid (Joy-said-insulin).
- *Laboratory report*. There was insulin on the used hypodermic (lab-insulin)
- *Gym records*. Joy had hardly taught Sunny (Joy-records).

<sup>3</sup> There are a number of descriptions of the case on-line, for example there is a lengthy but readable account at [www.trutv.com](http://www.trutv.com). It was filmed as *Reversal of Fortune* in 1990 starring Jeremy Irons as Claus and Glenn Close as Sunny.



**Figure 1: Model of first trial from Thagard.**

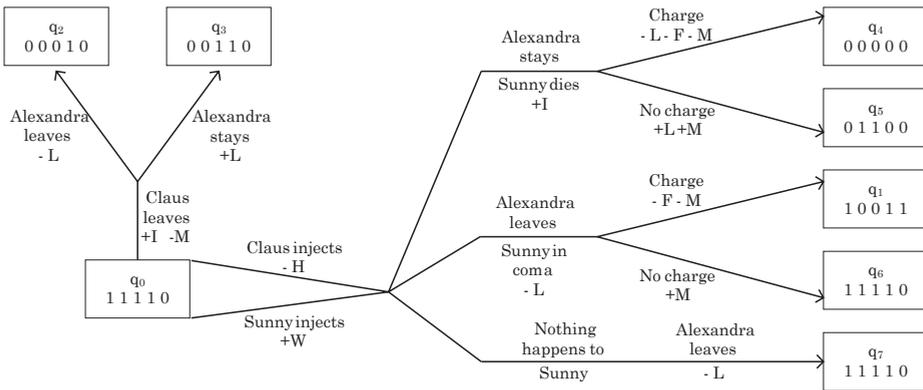
The prosecution argued that Joy’s evidence was not reliable, since it was contradicted by the gym records, but that the other testimonies should be believed. The evidence of Maria, Alex, Cahill and the lab report established that Claus had the means to inject Sunny. The testimonies of Alexandra and Sunny’s banker supplied a motivating story for Claus: that he loved Alexandra and wanted to end his marriage to Sunny, but that he also wanted to inherit the money (Claus had no independent means, and his opulent life style was supported by Sunny’s money). The defence story was based on Joy’s testimony and was that Sunny had injected herself with insulin as part of her eccentric health regime. These explanations are represented in Thagard as causal explanations and motive, but as can be seen above they are not treated differently in his model.

In our approach we will begin by focussing on the motive. We need first to identify some states and some transitions between them. We take the relevant features of the situation to be that Claus enjoyed a lavish lifestyle, but was dependent on Sunny for his money, that Claus was with Alexandra, and that Sunny was alive and conscious. We thus form our states from the five propositions:

- Dependent (Claus)
- LavishLifestyle (Claus)
- Together (Claus,Alexandra)
- Alive (Sunny)
- InsulinComa (Sunny)

Before Sunny went into a coma, the first four of these were true and the last was false, which we write as 11110.

Next we need to consider what actions might have been performed. Claus could leave Sunny, do nothing, or inject her with insulin. There are, of course, other possible actions, but these are all we need to consider here: alternative ways of attempting to kill Sunny are not of concern, and any other action can be taken as doing nothing since it has no relevance to the situation of interest. Sunny could do nothing or inject insulin. Alexandra could do nothing or leave Claus. We also need to consider that the effect of the injection could be one of three things: Sunny could control her weight, fall into a coma, or die. Finally we need to consider the police actions: they could charge Claus or accept accidental death. This gives us the transition diagram shown in Figure 2. Only the relevant states are shown.



**Figure 2: AATS for motive.**

We have labelled the transitions in the diagram with motives. Assuming that Claus loves Alexandra, or at least wishes that they stay together, his motivation of *love* (L) would be promoted where they remain together and demoted where they part. Claus is currently dependent on Sunny: he may well wish to be independent, so the motivation *independence* (I) is promoted when he leaves Sunny or she dies. But Claus was a notorious sybarite and so also might be motivated by a *lavish lifestyle* (M). Claus also is likely to value his *freedom* (F). We also have a motivation *honesty* (H) which is intended to embrace all the right reasons for obeying the law, such as respect for life, concern for reputa-

tion, moral reasons etc. Finally, Sunny was known to be concerned about her weight, and so controlling this (W) is a motivation for her.

The actual situation reached was q1. Obviously this situation was intended by neither Claus nor Sunny. The prosecution suggestion is that Claus was attempting to reach q5 by injecting Sunny with insulin, which would have satisfied three of his motivations, at the expense of Honesty, while the defence claims that Sunny was attempting to reach q7, which would have satisfied her motivation of weight loss.

The prosecution invites us to consider Claus in q0. He would have had three arguments based on AS1 for injecting Sunny, one for each of the values, and we will collapse these arguments into one:

CA1: In q0 I should inject to reach q5, which will promote L, I and M.

This is an instantiation of the standard practical reasoning scheme AS1 stated earlier. In the case the defence tried to tell a different story based on Sunny's position in q0, namely:

SA: In q0 I should inject to reach q7, which will promote W.

There are also numerous critical questions the defence can pose against CA1. Let us consider each of the critical questions in turn. Because we identify the goal (G) with the new circumstances (S), we will not consider CQ3, CQ6, or CQ15.

- CQ1: This would require the state to have been other than q0. But it is easy to establish Claus' financial dependence and lifestyle: Alexandra's testimony establishes their relationship, Sunny was indisputably alive and not comatose. Thus this question cannot sensibly be answered negatively.
- CQ2: As the AATS in figure 2 shows, Claus injecting Sunny could lead to any of q1, q4, q6 or q7 rather than q5. CQ2 applies to reaching q1 or q6 which suggests that the belief that the insulin would prove fatal is mistaken. The other possibilities rely on different choices by relevant agents, and so are covered under CQ17.
- CQ4: Assuming the facts of q0, the only dispute is whether killing Sunny would promote M, since it might be that her money went elsewhere. But Sunny's banker testifies that Claus would inherit a large sum.
- CQ5: Although there may have been other ways of killing Sunny, these were not proposed. It could have been argued, however, that had Claus intended to kill Sunny he could have chosen some surer and less detectable method to increase the chances of reaching q5. Since, however, this might have encouraged the belief that he did in fact want to reach q5, it would be dangerous to present such arguments, and we will not consider any based on this question.
- CQ7: Claus could have promoted L and I simply by leaving Sunny: CA2 In q0 I should leave Sunny to reach q3 which will promote L and I.

- CQ8: None of these values are demoted in q5, so this question offers no assistance to Claus.
- CQ9: The action does demote H, which would provide Claus with a reason not to perform the action.
- CQ10: This question is important if we need to determine the particular motivation. In the current situation, however, Claus' reasons accrue rather than compete, and so we cannot use this question.
- CQ11: Again this question cannot be used, since we do not have any means of promoting other values in our problem formulation.
- CQ12: As the discussion of CQ1 implied, the circumstances were not only possible but in fact obtained.
- CQ13: Various bits of prosecution evidence were used to show that Claus had access to insulin, most notably the testimony of Alex and Maria.
- CQ14: Could injecting insulin have killed Sunny? The medical testimony would seem to establish this.
- CQ16: Are L, M and I really values that could motivate Claus? They seem common enough human desires to be acceptable.
- CQ17: It could be suggested that even if the insulin did kill Sunny, q5 would not be reached either because Alexandra would leave or because the police would charge Claus.

Based on these critical questions, the following counterarguments to CA1 can be constructed:

- ACQ1: Claus was not in love with Alexandra
- Aq1: Sunny would not die, and Claus would be charged, demoting F, M and L
- Aq4: Claus would be charged with Sunny's murder, demoting F and M
- Aq6: Alexandra would leave anyway, demoting L
- Aq7: Sunny would neither die nor fall into a coma and Alexandra would leave, demoting L
- ACQ4: Claus would not inherit
- CA2: In q0 I should leave Sunny to reach q3 which will promote L and I (as stated above)
- ACQ9: Injecting Sunny demotes H
- ACQ13: Claus had no access to insulin

These arguments in turn, however, have counterarguments of their own.

- TA: ACQ1 is attacked by Alexandra's testimony
- WC: Aq1 and Aq4 are attacked by the belief that Claus will not be charged.

- PF: Aq1, Aq6 and Aq7 are attacked by the belief that the injection will prove fatal
- TB: ACQ4 is attacked by the banker’s testimony
- Aq2: CA2 is attacked by the belief that Alexandra will leave if Claus has no money (CQ2). This is itself attacked by AS, the belief that Alexandra will stay.
- MD: CA2 is attacked since it will demote M (CQ9)
- CA1: CA1 attacks CA2 through CQ7
- PT1: ACQ13 is attacked by Alex testimony
- PT2: ACQ13 is attacked by Maria’s testimony
- AS: Aq6 is attacked by the belief that Alexandra will not leave if Claus has money

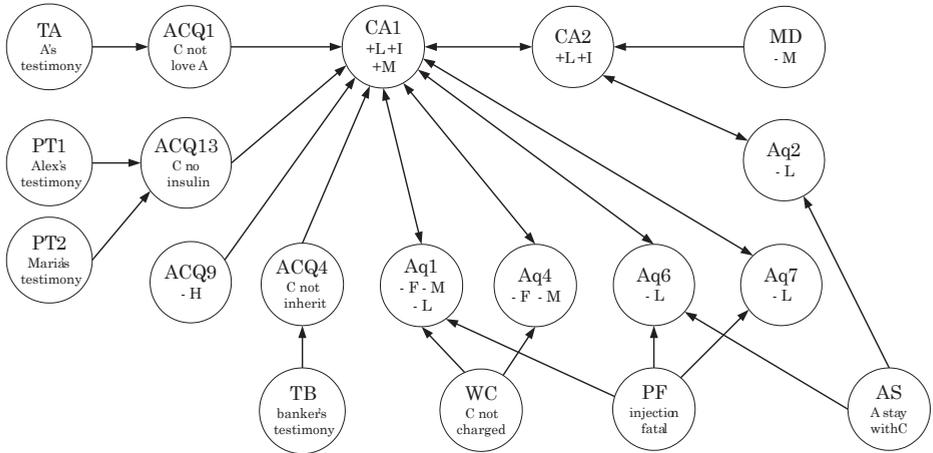


Figure 3: VAF for the scenario.

We now arrange these arguments as a Value Based Argumentation Framework (VAF) [3]. The framework shown in Figure 3 is not a standard value-based framework: for clarity, and because here different motives reinforce one another rather than conflict, we have collected several arguments together. CA1 is thus associated with all three values promoted in q5. We have arguments from the various alternative states that might be reached (i.e. CA2, Aq1, Aq2, Aq4, Aq6,Aq7), associated with the values they demote or fail to promote. Note that SA, while it counts as an alternative, is not included in the VAF because it was so decisively defeated by Joy’s testimony. Recall that the alternatives all attack each other. However, because the focus here is on CA1 and CA2, we have not drawn the attack arrows between the other alternatives (e.g. between Aq1 and Aq2). We have arguments relating to the factual assumptions that Claus can make to rebut certain of the critical questions and arguments about Claus’ beliefs at the

time (e.g. that he won't be charged and that Sunny will die). Finally we have the argument CQ13, which relates to means. When evaluating we give the argument the strength of the highest ranked value.

Now let us put ourselves in the position of the jury. The various testimonial evidence was unchallenged, and so TA, TB, PT1 and PT2 are all accepted. If this is so, ACQ1, ACQ13 and ACQ4 are all defeated. Now it is critical to judge that Claus would decide for CA1 rather than CA2. Suppose first that Claus believed that Alexandra would leave if he had no money. Then Claus would have a reason to reject CA2 and so accept CA1: only by killing Sunny could he keep Alexandra. But let us suppose that Claus believes that Alexandra will stay even if he has no money, so that Aq6 can be discounted. Now consider some other possible value orders. We will consider L+I as a single value, since they are always together in the relevant arguments.

- $H > M > L+I$ : here Claus cannot accept CA1 because of respect for the law, but equally cannot accept CA2, as it would lose the money. Here Claus does not inject Sunny, but rather does nothing, accepting that Alexandra will leave.
- $H > L+I > M$ : here Claus accepts CA2 and leaves Sunny.
- $M > L+I$ : here CA2 falls to MD, and so CA1 is accepted, provided  $M > H$ .

From this a picture of the kind of person Claus must be to accept CA1 rather than CA2 emerges: he must be very motivated by a desire to preserve his lifestyle, but must also prize L over H. Unless this is so, he will either simply leave, or stay, depending on the importance of his feelings for Alexandra. It requires both M and L to be greater than H to accept CA1. But CA1 is still open to challenge in that he may not succeed in killing Sunny and escaping the consequences. Suppose that Claus did believe PF. Now only if he prized I over F would he discount the possibility of being charged, and it is hard to believe that he would have had this value order.

Thus the prosecution needs to convince the jury that Claus had certain preferences and certain beliefs. With regard to preferences, the prosecution needs to tell a story in which Claus ranks  $M > L+I > H$ . With respect to beliefs they would prefer for the jury to believe that Claus thought that Alexandra would leave if Claus had no money, since this defeats CA2 irrespective of Claus' preferences. It is, however, more plausible to think that Alexandra would stay with Claus if he left Sunny: she had asked him to leave Sunny and, as a successful TV star (*Dark Shadows*, a cult series which ran from 1966-71), did not really need money from Claus. This removes an objection against CA2, but Claus can still accept CA1 on the basis of the preferences just mentioned. The prosecution need not, therefore express any particular position on this. Next the jury must accept that Claus believed the injection would prove fatal. This is important, since otherwise CA1 cannot be acceptable, but the jury could very well accept this, since Claus is no medical expert, and such an injection might have proved fatal. The final question is whether Claus accepted WC,

even though surrounded as he was by hostile servants and step children it seems inconceivable that he could have believed that he would not be the prime suspect. Since F is likely to be highly prized by Claus, the arguments that he would be deterred by the prospect of being caught are strong ones. Somehow, therefore the jury must also be convinced that he was sufficiently reckless or self confident to discount this possibility, and so be prepared to run the risk of being charged rather than not promote M<sup>4</sup>.

Suppose the jury did accept that Claus could have been motivated as suggested by the prosecution, and had the appropriate beliefs. The defence story was that Sunny had injected herself, and was supported by the testimony of Joy. This was challenged and fairly easily discredited. This left the prosecution story, showing means and motive as the only option, and it can be seen as plausible on a certain view of Claus's character. Evidently the jury took this view in the trial.

Thagard's approach is to use an artificial neural network that represents propositions by artificial neurons and represents coherence and incoherence relations by excitatory and inhibitory links between the units that represent the propositions. Acceptance or rejection of a proposition is represented by the degree of activation of the unit. As can be seen from Figure 1 the only inhibitor in the first Trial relates to the defence story, and so there is no real contest.

But let us consider, from our analysis of the arguments presented above, how the defence might have done better.

1. They might have been able to propose an alternative story more convincing than AS.
2. They might have been able to challenge the various pieces of prosecution testimony as to fact to provide some reason to reject TA, PT1 and PT2.
3. They might have disputed the motive. TB is particularly important in that without it M ceases to be a value promoted in CA1. Without M, it is no longer possible to attack CA2 on the grounds that it demotes M, or to defend CA1 by claiming that Claus preferred M to H. Thus without TB to support M as a motive CA2 looks like the more plausible choice for Claus, even if we continue to believe WC.
4. They might have argued that Claus could not have believed that he would not be suspected
5. They might have argued that Claus valued Honesty too much to commit the crime, or did not consider maintaining his lifestyle to be of importance.

Some of these improvements were actually considered in the second trial, which we will consider now.

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<sup>4</sup> At the trial no evidence was presented as to Alexandra's financial status. Had it been shown that she could have supported Claus in the style to which he was accustomed, M would become a lesser factor. However, now leaving Sunny would exchange dependence on one woman for dependence on another, as I would in this story have become the dominant motive, perhaps even worth risking his freedom for.

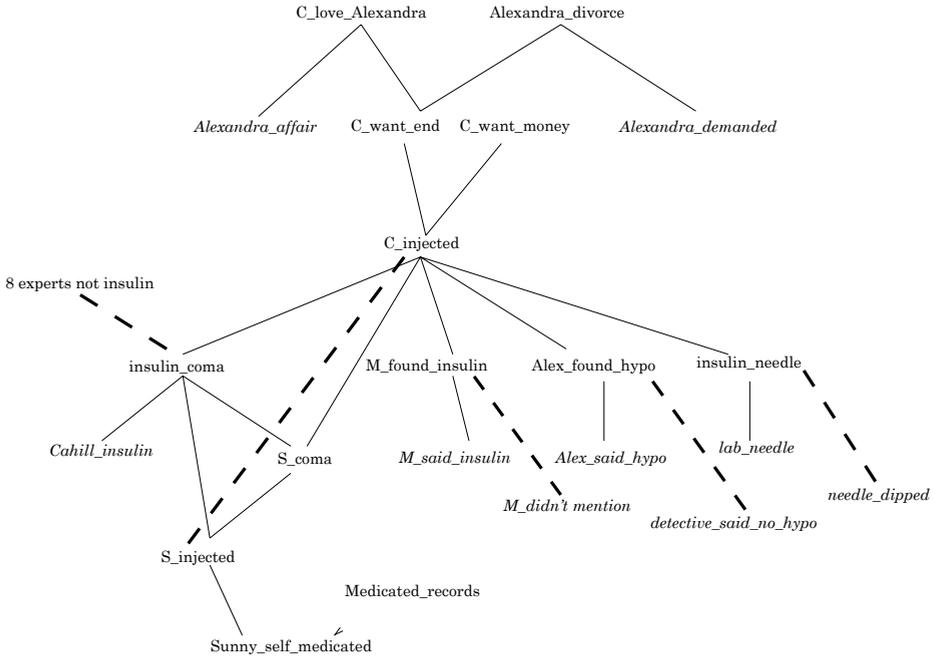
## 4.2. The Second Trial

In the second trial the defence was very different. This time Claus was represented by Alan Dershowitz, a Harvard Law School professor whose mastery of the appeals process is widely recognised, and who is among the best American appellate lawyers. First Dershowitz called expert witnesses to testify that Sunny's coma was not insulin induced, but was explained by a different story relating to Sunny's many health problems and strange health behaviours (she had, for example, on occasion taken large amounts of aspirin and other drugs). This provides a much better basis for an alternative story than did the original story based on Joy's testimony. Instead of having to attribute to Sunny the unusual belief that insulin helped weight loss, and so requiring an implausible witness to establish this, they could rely on Sunny's known hypochondria and penchant for self-medication. This is improvement (1) from the last section.

Even though the defence was arguing that the coma was not insulin induced, they discredited the testimony of Maria (she had not initially mentioned the insulin in Claus's bag) and Alex (a detective who was with Alex when the bag was found had not seen any needles). Moreover they claimed that the hypodermic had been dipped in insulin rather than used to inject it. This casts doubt on PT1 and PT2, so reinstating ACQ13 (improvement 2 from the last section). Now even if the medical evidence that Sunny's coma was not insulin induced is rejected, doubt has been cast on whether Claus had the means to commit the crime.

Thirdly Dershowitz managed to get the banker's testimony about the money Claus would inherit excluded, so that M has to be excluded from Claus' motivation (improvement 3 above). Improvements 4 and 5 were not considered necessary.

Now the prosecution case falls apart: Claus possibly did not have the means to inject insulin, and anyway insulin was not responsible for the coma. Moreover with the money element excluded from consideration, it would appear that Claus would have ended up independent but poor and this could have been achieved without risk by simply leaving Sunny, destroying the plausibility of Claus accepting CA1 rather than CA2. Revaluating the VAF of Figure 3 without TA, PT1, PT2 and TB, leaves CA2 as the most acceptable argument. Similarly, Thagard's model of the second trial, shown in Figure 4, gives the defence the more coherent story, since inhibitory links now are associated with all the factual contentions of the defence, and the excitatory link from the banker's testimony has gone, and the inhibitory links casting doubt on the defence testimony have also disappeared. In contrast to the model of the first trial there are now so many inhibitors undermining the prosecution that the story cannot establish itself as coherent.



**Figure 4: Model of second trial using Thagard’s propositions.**

Although Thagard’s approach, like ours, succeeds in giving the correct answer for the two cases, the differences between his models of the two trials is overwhelming. A fairer test would be to suppose that the banker’s testimony was excluded from the first trial removing the second prong of the prosecution story about Claus’s motivation. This would not make any difference to the explanatory coherence of the prosecution story using Thagard’s model, since removing this excitatory link would not change the overall picture to any great extent. In our approach, however, where we can also consider matters from the intentional stance, it could make a considerable difference. If Claus was not going to inherit, if Sunny died and Claus was not charged, the state would be 00100 (new state q8) rather than q5 on the banker’s testimony. This state q8 promotes only L and I, and this could have been achieved by leaving Sunny without demoting H, and without any risk to F. Thus, on our account the money element is essential rather than only supportive as in Thagard. The problem with Thagard’s approach, from our perspective, is that although in his representation he distinguishes between causal explanations and motives, their effect on execution is identical, both acting as excitatory links in the same way. Thus, for Thagard, the excitatory link for Claus wanting to end his marriage causes Claus to inject Sunny is no different from that for the injection causing the coma. In particular there is no consideration of the alternative choices that Claus could have made, and no attempt to rationalise why Claus should have chosen to act on any particular motive, which is the case in our account.

## 5. Concluding Remarks

In this paper we have considered the role played by motive in persuading people of a person's guilt or innocence. Like Thagard we consider that the reasoning involved in such cases can be seen as inference to the best causal story. Unlike Thagard, however, we believe that it is important to consider the story not only from a physical stance, in which motives cause people to act in much the same way as eating causes them to be overweight, but also from an intentional stance, so that they can be seen as rational agents making rational choices. Many aspects of the story depend on rational individuals making choices as to what to do, and while the existence of a motive does provide a reason for them to choose the action it is typically the case that there will be other motives, or alternative ways of acting on the motives. In order to believe that the story is the best explanation of the crime, we have to accept that the suspect could have believed that the action was the best choice in his particular situation. In order to provide this intentional stance we make use of the approach to practical reasoning developed in [2] which enables us to identify the arguments that would have been available to the suspect, and to characterise the type of person who would have chosen as the suspect is alleged to have done.

This last aspect brings us on to the notion of character evidence, as discussed in [12]. We do not, however, discuss character evidence, other than to note that the role of character evidence is to establish that the suspect could plausibly have the ordering on values and motives required to make the choice he is alleged to have made. Nor do we discuss the admissibility of motive and character evidence, the central issue of [10] and touched on in [13]: rather we simply accept, like Thagard, that beliefs as to motive and character play an important role in the jury's assessment of the plausibility of the account of events presented, and do not consider how these beliefs are produced through the presentation of evidence.

Taking the case of Claus von Bülow as a case study enables direct comparison with Thagard's use of the case to demonstrate his own approach [11]. We believe that we have shown that like Thagard we are able to account for the decisions in the two trials. We would, however, claim the further advantage that our explanation is more transparent, being couched as explicit arguments, rather than resulting from the implicit operations of a connectionist algorithm. Moreover, although the evidence in the two trials was sufficiently different to make the outcomes relatively clear, in a case in which the evidence was rather less obviously stacked in favour of a particular side, the crucial questions can be readily identified from our explicit arguments. An example of this is the importance of the financial motive in the von Bülow case: while Thagard's model does not require this additional motive to produce a guilty verdict for the first trial, our account shows that without it Claus' alleged behaviour becomes far less plausible as he had easier and safer ways of achieving his other ends. This kind of scenario emphasises the need to consider the intentional stance. Whereas physical causes can be reasonably considered to have determinate

effects, motives may or may not be acted on. Moreover, while causes *typically* give rise to their effects, so that it is when they do not that requires explanation in terms of some *abnormality* in the situation, the motives for a crime are typically not acted on: most people obey the law. Therefore some unusual feature of the situation which led this particular suspect to act on the motive in this particular case needs to be incorporated in a story if it is to be compelling.

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# An OWL Ontology for Legal Cases with an Instantiation of *Popov v. Hayashi*

Adam Wyner

Department of Computer Science  
University College London  
Gower Street, London WC1E 6BT, United Kingdom  
adam@wyner.info  
www.wyner.info/research/

**Abstract.** The paper provides an OWL ontology for legal cases with an instantiation of the legal case *Popov v. Hayashi*. The Protégé ontology editor and knowledge acquisition system is used to develop the ontology and represent *Popov v. Hayashi*. We use the Protégé plugin ACE View which allows the ontology and instantiation to be expressed and edited in natural language; the sentences are parsed and interpreted as OWL expressions. An ontology makes explicit the conceptual knowledge of the legal case domain and supports reasoning. Instantiating cases creates a case base which can be used for information retrieval, information extraction, or case based reasoning.

**Keywords:** ontology, legal cases

## 1. Introduction

In this paper, we provide an OWL ontology for legal cases with an instantiation of a particular legal case – *Popov v. Hayashi*<sup>1</sup>. The elements of the ontology are drawn from a range of sources including typical legal search features, previous theoretical research on legal case ontologies, and research on case based reasoning. For the purposes of this paper, we focus just on the elements of the ontology which are relevant for modeling *Popov v. Hayashi* as found in the decision itself as well as in [1] where argumentation schemes and value-based reasoning are introduced. To develop the ontology and instantiate it, we have used the ACE View Protégé plugin; this allows the user to express and review the ontology using sentences in natural language. The novelty of the paper is: a fuller more explicit ontology of legal cases than in previous research, the

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<sup>1</sup> ©Adam Wyner, 2009. This paper was presented at the Workshop on Modeling Legal Cases, International Conference on Artificial Intelligence and Law, Barcelona, June 8, 2009. The OWL ontology which is discussed here is available upon request from the author. The case citation is: *Popov v. Hayashi*, 2002 WL 31833731 (Cal.Superior Dec 18, 2002) (NO. 400545).

instantiation of a case such as *Popov v. Hayashi* in this ontology, and the application of ACE View to develop a legal ontology.

The scope of the paper is restricted to the identification of the main ontological elements of cases along with their object and data properties. As is discussed in the course of the presentation, a range of issues are not addressed such as legal reasoning rules, details of particular legal hierarchies, and full lists of legal subjects or causes of action. The ontology provides a basis for marking up case documents systematically and coherently so as to support information retrieval, information extraction, and case based reasoning whether in stand alone databases or over the internet. In general, the ontology is intended to be a basis for further discussion and development.

In the following, we provide an overview of the representation technique, the context of use, the ontological representation, then conclude with some discussion.

## 2. Overview of Representation Technique

In this section, we provide brief overviews about OWL ontologies, the Protégé ontology editor and knowledge acquisition tool, and the ACE View Protégé plugin.

### 2.1. OWL Ontologies and Protégé

We outline some of the main reasons for providing an ontology in OWL and using the ontology development tool Protégé ([2] and [3]), with particular reference to issues related to ontologies in the legal domain ([4] and [5]).

An ontology explicitly and formally specifies a conceptualisation of the properties of and relations between objects in a given domain ([6, p.10], [7], [2], and [3]). In the legal domain, ontologies have been found useful as well ([4], [5], and [8]). A common vocabulary and framework is provided in an ontology so that researchers can share, test, and modify the conceptualisation. To provide an ontology, one gives *classes* of objects along with their properties such as attributes; one also specifies the *relationships* among the various objects of the ontology. Given instances of the classes, we have a *knowledge base*. One can then apply rules such as *production rules* to elements of the knowledge base to draw additional inferences from the knowledge base.

We have developed our case ontology in the Ontology Web Language (OWL) using the Protégé ontology editor and knowledge acquisition tool. OWL provides a machine readable ontology which can then be processed by *Semantic Web* applications. While OWL provides a range of *flavours*, each associated with a degree of logical expressiveness and associated computational properties, for our purposes, OWL Lite has been sufficient. The Protégé ontology editing and knowledge acquisition tool supports systematic development of an ontology

along with structured instantiations; we have used a recently released version Protégé 4.0 Beta which supports ontologies for so-called *Web 2.0* in which rich semantic information and rules can be processed over the internet. Protégé enables users to *query* the knowledge base, test an ontology for *consistency*, draw inferences, and apply rules to elements of the knowledge base. However, as our focus is on formally modeling a legal case, we primarily present the ontology; moreover, reasoning about cases presupposes the ontology.

## 2.2. ACE View

One additional feature of Protégé is that it provides a plugin framework, allowing the development of a range of tools. We have used the tool *ACE View*, which is an ontology and rule editor that uses Attempto Controlled English (ACE) to create, view and edit OWL 2 ontologies and SWRL rulesets<sup>2</sup>. Attempto Controlled English (ACE) is a controlled natural language, where a controlled language is a formal specification of a subset of English with a large vocabulary and an expressive set of grammatical constructions<sup>3</sup>. Once having learned how to author expressions (which is relatively easy), expressions in ACE write and read as standard English. As a formal language, ACE texts are computer-processable and unambiguous. Sentences are parsed and translated into *Discourse Representation Structures*, which provide a syntactic variant of first-order logic; ACE provides for consistency checks and inferencing. ACE View supports bidirectional translation of expressions between ACE and OWL description logic. With ACE View, one can create OWL/SWRL knowledge bases, open OWL 2 ontologies and view them as ACE texts, and edit OWL/SWRL knowledge bases. ACE View has a variety of views:

- ACE Snippet Editor: This allows single sentences to be added to or deleted from an active ACE text (the text which is being translated into OWL).
- ACE Text: The active ACE text as plain text.
- Lexicon: The active lexicon as a table.
- ACE Q & A: Questions and their answers in the active ACE text
- ACE Entailments: The entailments derived from the active ACE text.

For example, we can enter each of the following sentences:

1. Every man is a human.
2. Bill is a man.
3. Who is a human?

<sup>2</sup> <http://attempto.ifi.uzh.ch/aceview/>

<sup>3</sup> <http://attempto.ifi.uzh.ch/site/>

In this example, *a man* represents the *class* of entities which are men as opposed to the existential interpretation found in *A man walked in*. Unless made explicit, it is not supposed that relations are functional; for example, a case may be functionally defined to have only one citation index, but allow for the same case to have several hearing dates.

The sentences [1]-[3] are syntactically parsed and mapped to correlated elements in an OWL ontology. The term *man* and *human* are classes, where the class *human* is a subclass of *thing* and where *man* is a subclass of *human*. “Bill” is introduced as an individual in the ontology. The ontology is graphically represented in Figure 1.



Figure 1: Graphic of an Ontology written in ACE View

Applying the reasoner *Pellet*, we can open the ACE Q & A view, highlight the question *Who is a human?*, and see the answer “Bill”. We can also view serialised versions of the ontology such as this assertion that *Bill is a man*; note the annotation for the *acetext*.

```

<ClassAssertion>
  <Annotation annotationURI="&acetext;acetext">
    <Constant>Bill is a man.</Constant>
  </Annotation>
  <Class URI="&TESTTEST01;man"/>
  <Individual URI="&TESTTEST01;Bill"/>
</ClassAssertion>
  
```

For our purposes, it is clearer, easier, and more comprehensible to simply present the ontology with the sentences. While it may be that in some circumstances *a picture is worth a thousand words*, in our context, the linguistic representation in the ontology maintains a closer link to the linguistic representation of the case. It is also a more accessible format for legal professionals who may then be involved in developing and maintaining the ontology.

As a controlled language ACE is restricted, yet it is nonetheless expressive. Object properties are predicates of subjects and are expressed with a transitive verb phrase (or adjectival phrase) that contains a direct object with a proper name or previously introduced individual; for example, in *Every man knows John*, the transitive verb phrase is *knows John* predicates of the subject *Every man*. Data properties use the copula “is”, a genitive construction, and a noun that expresses the property; for example, in *Jocasta’s child is Oedipus*, the property of having a child ascribed to the individual *Jocasta* has the value *Oedipus*. The language can also express complex classes using negation, disjunc-

tion, and conjunction; there are quantifiers for noun phrases (e.g. every, no, a). A disjoint class would be expressed in ACE as *No man is a woman*. Properties can be transitive, irreflexive, symmetrical, and so on; for example, symmetry of the *love* relation is expressed as *Everybody who is loved by somebody loves him*. If two properties are equivalent, they are superproperties of one another: *Everybody who hates somebody despises him* and *Everybody who despises somebody hates him*. ACE has a vocabulary of approximately 100,000 words.

There are a range of restrictions in ACE View. For example, adjectives in noun phrases (e.g. “tall” in *The tall woman is happy*) are allowed in ACE, but not in ACE View. There are a range of other grammatical constructions which are not available, but for our current purposes this is not central; for example, as ACE View adheres to OWL, it is not as expressive as SWRL rules. Once one learns the range of grammatical constructions, then the language is easy and expressive. If one wants to introduce complex terms that are not available in ACE, they can be used as basic terms such as *precedent\_case*. We use this in our sample ontology. As the expressiveness of ACE View extends, so too will its utility as a tool for ontological representation. Further details about the capabilities of ACE in general and ACE View in particular are available on the website.

### 3. Context of Use

Formal, machine-readable ontologies have a range of contexts of use and applications. Ontologies, as representations of knowledge, help us to understand the knowledge under investigation. With a web-oriented tool such as Protégé, ontologies can be used to represent and reason about some domain of interest with a web-based application. Moreover, as a structured representation of knowledge, an ontology can facilitate knowledge acquisition, supporting users to build up large, instantiated databases which can subsequently be queried or reasoned with. Building databases can either be a manual task (users enter values for fields) or automated with information extraction and retrieval techniques (where those techniques can successfully and systematically identify the relevant fields).

In our particular domain of interest, legal case representation and case-based reasoning, these contexts of use focus on the legal domain. The ontology could be used to make explicit the implicit knowledge of legal cases which legal professionals have; it could be used as a tool to build a database of cases; with a database of cases, we could apply automated case-based reasoning rules; with a web-based tool, case representation and reasoning could be done over the internet. At this point, building the case base is a manual task, as automated text mining are not yet sufficiently well-developed to bind textual cases to the fields of the ontology (see [9], [10], [11], [12], [13], [14] and [15]). In contrast, in areas such as bio-informatics and pharmacology, rich ontologies support text search and mining; there is a significant commercial interest in this area (see

Linguamatics at [www.linguamatics.com](http://www.linguamatics.com)). Finally, an ontology could be used to support legal training by providing an explicit representation of case knowledge that can be tied to particular instances.

It is important to keep in mind a distinction between how a particular property comes to hold of a case relative to the ontology and the ontological representation itself. For example, each case has a cause of action which is put forth at the pleadings phase of the legal procedure; a cause of action could be something like *trespass to chattel*. We assume the *outcome* of the pleadings phase and represent that a cause of action such as *trespass to chattel* holds in the case; in other words, we do not represent how it comes to be that the cause of action holds. Similar considerations can be made of the introduction of evidence or of the judgment. At this point of our analysis, the ontology largely relates to the properties as they are given in the case decision. To represent how the values of such elements are assigned over the course of a legal procedure, one would have to introduce rules of legal reasoning such as those of [1] or [16], which are beyond the scope of this ontology at this time. Nonetheless, we may, where feasible, derive properties; for example, if a case has precedents, we may want this to be implied by one case citing another case which temporally precedes the citing case.

## 4. Ontological Representation

In the following, we have all the main subclasses of *thing* which relate to the ontological representation of a case. The structure of the ontology is derived from a range of sources and serves different purposes; we refer to these sources in the discussion section. For example, where one uses search engines for case bases, a variety of parameters can be searched such as legal subjects and jurisdictions. The current version of the ontology includes the elements for case based reasoning relative to case factors as reported in [8]; we do not discuss these elements further here but to say that case based reasoning may relate to inferences drawn from a range of case information, not just case factors.

We have divided the presentation into an abstract representation of a case ontology and a particular instantiation with *Popov v. Hayashi*. Some elements are included only schematically as they are not relevant to the representation of *Popov v. Hayashi*, for example, case based reasoning components, legislation, evidence, and others as indicated. A fuller presentation of case based reasoning would include all these elements. Moreover, as indicated at the onset, the scope of the ontology is limited to high level structures and a few instantiations of particulars; several elements can be regarded as “stubs” which hold a place for later development. However, there is more in the current version of the ontology than can be feasibly represented here, for which one must consult the ontology. Indentation should be taken to indicate subsumption. There are currently over 300 sentences in the ontology, including instantiations, additional expressions for disjoint sets, class characteristics, and others.

## 4.1. Abstract

### 4.1.1. Acts of Legislation

A case may cite or be judged with respect to an act of legislation. This is particularly relevant in *civil law* settings, where legislation and associated legal literature are predominant. As this is not relevant to a representation of *Popov v. Hayashi*, we have not developed this part of the ontology.

- Every `act_of_legislation` is a thing.

### 4.1.2. Argument Schemes

Argument schemes are prototypical reasoning patterns. [1] analyse the legal reasoning in *Popov v. Hayashi* with a range of argument schemes. We hypothesise that every case includes some such schemes.

- Every case uses an `argument_scheme`.
  - Every `defeasible_modus_ponens_argument_scheme` is an `argument_scheme`.
  - Every `expert_testimony_argument_scheme` is an `argument_scheme`.
  - Every `eyewitness_testimony_argument_scheme` is an `argument_scheme`.
  - Every `purpose_argument_scheme` is an `argument_scheme`.
  - Every `video_tape_argument_scheme` is an `argument_scheme`.

### 4.1.3. Case

Cases have a range of object properties, many of which are elaborated below. We also have a distinction between current cases and precedents. Precedents are cases which are cited by a case and temporally precede the citing case; we have not introduced calculations relative to dates. Current cases and precedents are disjoint. A main difference is that current cases are undecided, while precedents are decided. In principle, it should be possible to write a SWRL expression to infer the precedents of a case: Every case that is `cited_by` a case X and that `temporally_precedes` the case X is X's `precedent_case`. However, in the current version of Protégé with Ace View, there appear to be some parsing bugs. We comment further on precedential values (e.g. overturning a decision) below.

- Every case `has_address` an address.
- Every case `has_case_name` a `case_name`.
- Every case `has_causes` a `cause_of_action`.
- Every case `has_citation` a `case_citation`.
- Every case `has_defendant_solicitor` a `defendant_solicitor`.

- Every case has\_evidence an evidence\_element.
- Every case has\_factors a factor.
- Every case has\_hearing a hearing\_date.
- Every case has\_legal\_issue a legal\_issue.
- Every case has\_legal\_subject a legal\_subject.
- Every case has\_participants a case\_participant.
- Every case has\_party a defendant.
- Every case has\_party a plaintiff.
- Every case has\_plaintiff\_solicitor a plaintiff\_solicitor.
- Every case has\_references a legal\_reference.
- Every case has\_witnesses a witness.
- Every case is\_heard\_by a judge.
- Every case is\_heard\_in a jurisdiction.
- Every case is\_reported\_by a court\_reporter.
- Every case relates\_to a legal\_value.
- Every case uses an argument\_scheme.
- Everything that cites something is a case.
- Everything that is\_cited\_by something is a case.
- Every current\_case is a case.
  - No current\_case is\_in a case\_base.
  - Every current\_case benefits a case\_party which is an unknown\_party.
  - No current\_case is a decided\_case.
  - Every current\_case has\_decided no case\_decision.
  - Every current\_case has\_decision\_date an unknown\_decision\_date.
  - Every current\_case cites a precedent\_case.
- Every decided\_case is a case.
  - Every decided\_case is\_in a case\_base.
  - Every decided\_case has\_decided a case\_decision.
  - Every decided\_case has\_decision\_date a known\_decision\_date.
  - Every decided\_case benefits a case\_party which is not an unknown\_party.
  - Every precedent\_case is a case.
    - \* Every precedent\_case is a decided\_case that is\_cited\_by a case and that temporally\_precedes a case.
- Every shepardize\_case is a decided\_case.
  - \* Every overturning\_case is a shepardize\_case. (Similar classes for criticise, distinguish, upholding,...)

In searching the case base, one finds not only cases with the relevant factors, but also identifies *good* law relative to one's purpose. For example, if one finds a case with the relevant factors and a decision in favour of one's client, then the legal researcher wants to know if the decision in that precedent is still

being followed and by which level or court in the legal hierarchy. Alternatively, a legal researcher may seek cases associated with the opponent's position which have been overturned. This is standardly referred to as *Shepardization* of a case, and a range of case citation systems exist to identify and relate the relevant cases.

Shepardization can refer to the history of a case decision, e.g. whether a later case decision affirms, modifies, reverses, etc an earlier decision; it also relates to the treatment of the decision, e.g. whether the later decision criticises, distinguishes, explains, etc the earlier decision. To determine variations among the related cases, the legal researcher looks up the various indexed cases.

For our purposes, we simply introduce precedential values. In *Popov v. Hayashi*, we have a suit in first instance, so there is no previous decision to consider; there is little reasoning in this case concerning precedential values. We have introduced relational information between cases as an object property.

#### 4.1.4. Case Base

This is a place holder in the ontology for different case bases.

#### 4.1.5. Case Decision

We present several of the statements related to case decisions. For *Popov v. Hayashi*, we have introduced a split decision.

- Every `case_decision_for_unknown` is a `case_decision`.
- Every `decided_case` has `decided` a `case_decision`.
- Every `case_comparison` has `case_comparison_decision_for` a `case_decision`.
- Every `case_decision` benefits a `case_party`.
- Every `case_decision_for_plaintiff` is a `case_decision`.
- Every `case_decision_for_defendant` is a `case_decision`.
- Every `case_decision_for_split` is a `case_decision`.

#### 4.1.6. Case Index

Cases have a range of indicies. We have included jurisdictions among the indicies. Jurisdiction refers to the authority which has authority to adjudicate and administer justice over a case. There are a variety of ways that jurisdiction is decomposed – national, judicial hierarchy, and subject matter. In [17], formal aspects of judicial hierarchies and reasoning with appeal are presented. For our purposes, we have two national jurisdictions (US and UK) within which

we have a legal hierarchy, indicated with transitive subordination object property.

Matters of jurisdiction are considerably more complex and would need to be articulated further. In the US, there are circuits of courts, within which appeals are passed upwards in the hierarchy; in the UK, on some matters, England and Wales are a distinct jurisdiction from Scotland. Moreover, courts can be defined with respect to subject jurisdictions such as family or technology matters.

- Every address is a case\_index.
- Every case\_citation is a case\_index.
- Every case\_name is a case\_index.
- Every decision\_date is a case\_index.
  - Every known\_decision\_date is a decision\_date.
  - No known\_decision\_date is an unknown\_decision\_date.
  - Every unknown\_decision\_date is a decision\_date.
- Every hearing\_date is a case\_index.
- Every jurisdiction is a case\_index.
  - Every uk\_court is a jurisdiction. Subclasses: court of appeal, high court, house of lords, tribunal
  - Every uk\_house\_of\_lords legally\_subordinates a uk\_court\_of\_appeal.
  - Every us\_court is a jurisdiction. Subclasses: appellate, supreme, trial
  - No us\_court is a uk\_court.
- Every legal\_reference is a case\_index.

#### 4.1.7. Case Participant

Cases have a range of participants. Cases have a range of participants in addition to the defendant and plaintiff. Some components are more relevant for information extraction than they might be for case based reasoning. For example, for reasoning it is sufficient to know that a claim was made by a witness, not who the witness is. We have included an *unknown\_party* for current cases where the decision has not been made. We have also introduced two subsorts of witnesses; there can be more. The argument schemes ought to be related to the participants, but this will be left for further development.

- Every case\_has\_participants a case\_participant.
- Every case\_party is a case\_participant.
  - Every defendant is a case\_party.
  - Every plaintiff is a case\_party.
  - Every unknown\_party is a case\_party.
  - No plaintiff is a defendant.
  - No defendant is an unknown\_party.

- No plaintiff is an unknown\_party.
- Every case\_reporter is a case\_participant.
- Every court\_reporter is a case\_participant.
- Every judge is a case\_participant.
- Every solicitor is a case\_participant.
  - Every defendant\_solicitor is a solicitor.
  - Every plaintiff\_solicitor is a solicitor.
  - No defendant\_solicitor is a plaintiff\_solicitor.
- Every witness is a case\_participant.
  - Every expert\_witness is a witness. Subclasses: for defendant, for plaintiff
  - No expert\_witness is an eye\_witness.
  - Every eye\_witness is a witness. Subclasses: for defendant, for plaintiff.

#### 4.1.7. Evidence Element

In a legal proceeding, a range evidence is presented to the court in order to prove or disprove the legal issue such as the legal responsibility of a party or possession of some object. Among the types of evidence there are: testimony, documentary, physical, circumstantial.

Over the course of the legal proceedings, the lawyers (as well as perhaps the presiding judge) make arguments and statements about the evidence and their relation to the cause of action; the lawyers' arguments and statements are not, themselves, evidence. What the lawyers agree on may be taken as factual; for example, should a knife be introduced as evidence and the lawyers on both sides of the case agree that the knife is the murder weapon, then it can be taken as a fact that the knife is the murder weapon. A judge may, instead of the lawyers, make a determination of what is factual. Facts in the case decision are, then, a subspecies of evidence. These are distinct from the evidence which is not agreed on by any party as factual; the evidence need not be consistent, nor need all evidence which is introduced be used to support a judgement. It is important to reiterate that our primary objective is to provide an ontology for legal case decisions, taking as given what the legal system has determined is or is not a fact as well as how the facts are related to evidence.

Distinct from evidence, we have case *factors*, which are used in case based reasoning (CBR) ([18], [19], [20], [21], [22] and [8]). Factors are typical fact patterns in a case which bias the decision for or against a party in the case. Factors may also play a role in the sort of decision, for example, a driver may be found guilty of killing a pedestrian, but a distinction must be made between first and second degree murder. This distinction requires a determination of culpable intent, which in turn depends on a range of specific factors (e.g. evidence of premeditation). Similarly, a judge may make a decision relative to whether or not an obligation such as aiding a victim of a car accident was fulfilled or not.

Though closely related, we treat evidence and factors as distinct for three reasons. First, the introduction of evidence follows its own procedural rules (e.g. admissibility), and evidence appears as particulars of a case. Second, there may as well be conceptual issues as to what is or is not evidence. For example, an obligation to aid a victim of a car accident (relevant in a case concerning a hit-and-run car accident) is not evidence introduced into a case, but a legal “fact” that holds or not relative to the circumstances; it is, though, a factor which is supported by facts that are entered into evidence (e.g. witness testimony). Similarly, whether a driver was driving recklessly is not evidence, but can be supported by evidence such as testimony to support the claim that the car driver failed to heed traffic signs. The factors are crucial in comparing cases and in biasing the judge’s decision. Third, we reason with and organise evidence and factors in distinct ways: the sorts of argument schemes that apply to factors are different from those which apply to evidence (compare the argument schemes in [22] and [1]); factors are organised into factor hierarchies for the purposes of CBR (cf. [22] and the literature cited therein); evidence is organised into relationships of “lower level” facts supporting “higher level” facts, e.g. DNA, a finger print, a death by stabbing, and a knife may all be lower level facts that support the higher level fact that one individual stabbed another individual to death. Given these considerations, we have introduced evidence and factors in different parts of the ontology, and further relationships between them ought to be provided.

To have a cover term for evidence, we have *evidence\_element*; we distinguish facts, which are not disputed, from disputed evidence. Pending further investigation, we presume that the facts are those which either all case participants accept as factual or which the presiding judge asserts is factual contra one or the other legal representatives in the case.

- Every fact is an *evidence\_element*.
- Every *disputed\_evidence\_element* is an *evidence\_element*.
- *circumstantial\_data* is an *evidence\_element*.
- *legal\_testimony* is an *evidence\_element*.
- *physical\_data* is an *evidence\_element*.
- *legal\_documentation* is an *evidence\_element*.

#### 4.1.9. Legal Concept

This component of the ontology includes a diverse range of elements which are more abstract. Case comparisons in the sense represented here are central for case based reasoning particularly with respect to factors and decisions (case comparisons, partitions, factors, and some indicies) which are discussed in detail in [8]; we indicate how factors may be classed in terms of different domains, e.g. culpable intent and intellectual property. In addition, we have introduced causes of action, legal values, legal issues, and legal subjects. We discuss these in turn.

- Every *case\_comparison* is a *legal\_concept*.
- Every *cause\_of\_action* is a *legal\_concept*.
  - *trespass\_to\_chattel* is a *cause\_of\_action*. Others: legal conversion, constructive trust, injunctive relief.
- Every *factor* is a *legal\_concept*.
  - Every *culpable\_intent\_factor* is a *factor*.
  - Every *intellectual\_property\_factor* is a *factor*.
- Every *legal\_concept\_ID* is a *legal\_concept*.
  - Every *case\_comparison\_ID* is a *legal\_concept\_ID*.
  - Every *factor\_ID* is a *legal\_concept\_ID*.
  - Every *factor\_name* is a *legal\_concept\_ID*.
- Every *legal\_issue* is a *legal\_concept*.
- Every *legal\_subject* is a *legal\_concept*.
  - *discrimination\_law* is a *legal\_subject*. Others: employment.
- Every *legal\_value* is a *legal\_concept*.
  - *bright\_line\_of\_law* is a *legal\_value*. Others: maintaining public order, fairness in law.
- Every *partition* is a *legal\_concept*.
  - Every *case\_comparison\_defendant\_partition* is a *partition*.
  - Every *case\_comparison\_plaintiff\_partition* is a *partition*.

A cause of action is the plaintiff's claim which expresses the legal theory and which justifies bringing the case to court. It must be supported by claims of fact, the legally defined elements of the claim must be met for the claim to succeed, and the legal theory must provide for a remedy. The causes of action are pleaded in the initial complaint. There are a range of areas of law such as Torts and Contracts; Torts arise where there are no contractual obligations and cover intentional or accidental actions, where one party holds another party liable for damages. Given our target case, we consider only Torts.

There are a range of causes of action which are individual values of the data property *cause\_of\_action* for the case. We only consider the ones which are raised in *Popov v. Hayashi*: constructive trust, conversion, injunctive relief, and trespass to chattel. Each of these bears on property ownership and compensation. In *Popov v. Hayashi*, the judge outlines each of the causes of action, the claims of fact, and other legally defined elements so as to determine whether the cause of action is satisfied and the plaintiff wins the case.

This brief overview of causes of action indicates that the ontology must be enriched to more fully express this crucial aspect of legal knowledge. However, for our purposes in this paper, we simply make the causes of action individual values of the data property *cause of action*.

Factors in legal CBR are discussed in ([18], [19], [20], [21], [22] and [8]); the OWL ontology for legal CBR from [8] has been incorporated into the current ontology. However, as our current focus is the representation of a case *per se*, we leave issues related to CBR with respect to factors largely aside for the time being.

The most thoroughly studied analysis of factors in legal CBR relate to intellectual property in trade secrets cases (e.g. [18] and [22]). If a parent factor is *were questionable means used to get the trade secret?*, some of the related subfactors that are organised into a factor hierarchy are *was an employee bribed to get the trade secret?*, *was the trade secret reverse engineered?*, *was deception used to get the trade secret?*. Another high-level factor is culpable intent [23], for example, in determining whether a driver is guilty of murder or manslaughter of a pedestrian. This is determined with respect to a variety of particular factors such as *did the driver fulfill the obligation to aid the victim?*, *did the driver fail to heed traffic signs?*, and *did the driver fail to heed earlier warnings about reckless driving?* For the current ontology, we have only taken the high level factors into consideration; additional high level factors and the organisation of subfactors would be introduced with further research.

It should be noted that some of these high level factors may be relative to what the ontology represents as legal subject. For instance, subfactors of culpable intent may appear in intellectual property cases as well as murder cases. However, we leave further discussion for future research.

In abstracts of cases, specific legal issues at stake in the case under discussion are usually highlighted. In the case report itself, this might be less explicit. For information extraction and retrieval, it is useful to have an element of the ontology which gives access to these issues. There may be more than one legal issue per case.

In legal indices, cases are indexed with respect to the subject area such as employment, family, etc. We have given a small sample of such subjects.

One line of research in AI and Law gives prominence to legal values such as *fairness or the bright line of the law* ([24], [25] and [1]). In some cases, the legal values are explicitly expressed (e.g. *Popov v. Hayashi*) while in others, the analyst must infer this from the judgement (e.g. cases bearing on hunting wild animals such as *Pierson v. Post* and *Keeble v. Hickeringill*). We suggest that legal values of cases be made explicit. In the ontology, we have incorporated a sample of legal values that a case may have.

#### 4.1.10. Disjoint Classes

In the construction of the ontology, one must specify disjoint classes. These can be expressed in ACE View, however, it is very cumbersome to do so and difficult to maintain; therefore, it is easier to use the facilities of Protégé, which then appear in ACE View. For instance, current cases and precedent cases are disjoint; the ontology includes a range of other disjoint classes.

## 4.2. Popov v. Hayashi

In this section, we give elements of the instantiation of *Popov v. Hayashi* with respect to the ontology which we have just presented. In effect, we simply provi-

de the values of data properties associated with *Popov v. Hayashi*. The values are taken either from the case decision itself (e.g. cause of action, precedents, etc) or from the research literature (e.g. argument schemes).

- Popov\_v\_Hayashi cites Pierson\_v\_Post.
- Popov\_v\_Hayashi cites State\_v\_Shaw.
- Popov\_v\_Hayashi cites Young\_v\_Hitchens.
- Popov\_v\_Hayashi cites Zaslow\_v\_Kroenert.
- Popov\_v\_Hayashi is a case\_name.
- Popov\_v\_Hayashi is a decided\_case.
- Popov\_v\_Hayashi’s case\_citation is No400545CalSuperiorCourt.
- Popov\_v\_Hayashi’s case\_decision is Case\_decision\_for\_split01.
- Popov\_v\_Hayashi’s case\_name is Popov\_v\_Hayashi.
- Popov\_v\_Hayashi’s cause\_of\_action is constructive\_trust.
- Popov\_v\_Hayashi’s cause\_of\_action is injunctive\_relief.
- Popov\_v\_Hayashi’s cause\_of\_action is legal\_conversion.
- Popov\_v\_Hayashi’s cause\_of\_action is trespass\_to\_chattel.
- Popov\_v\_Hayashi’s defeasible\_modus\_ponens\_argument\_scheme is De-feasible\_modus\_ponens\_argument\_scheme\_1.
- Popov\_v\_Hayashi’s defendant is Patrick\_Hayashi.
- Popov\_v\_Hayashi’s expert\_testimony\_argument\_scheme is Expert\_testi-mony\_argument\_scheme\_1.
- Popov\_v\_Hayashi’s expert\_witness is Professor\_Bernhardt.
- Popov\_v\_Hayashi’s eyewitness\_testimony\_argument\_scheme is Eyewit-ness\_testimony\_argument\_scheme\_1.
- Popov\_v\_Hayashi’s fact is Alex\_Popov\_and\_Patrick\_Hayashi\_were\_posi-tioned\_to\_catch\_the\_home\_run\_baseball.
- Popov\_v\_Hayashi’s fact is Barry\_Bonds\_hit\_a\_record\_home\_run.
- Popov\_v\_Hayashi’s fact is Popov\_stopped\_the\_forward\_motion\_of\_the\_baseball.
- Popov\_v\_Hayashi’s judge is Kevin\_McCarthy.
- Popov\_v\_Hayashi’s known\_decision\_date is September012002.
- Popov\_v\_Hayashi’s legal\_issue is Pre-possessory\_interest\_in\_property.
- Popov\_v\_Hayashi’s plaintiff is Alex\_Popov.
- Popov\_v\_Hayashi’s purpose\_argument\_scheme is Purpose\_argument\_scheme\_1.
- Popov\_v\_Hayashi’s us\_appellate\_court is Superior\_Court\_of\_California.
- Popov\_v\_Hayashi’s video\_tape\_argument\_scheme is Video\_tape\_argu-ment\_scheme\_1.

Some cases which are precedents that are referred to in Popov v Hayashi:

- Young\_v\_Hitchens is a decided\_case.
- Young\_v\_Hitchens temporally\_precedes Popov\_v\_Hayashi.
- Zaslow\_v\_Kroenert is a decided\_case.
- Zaslow\_v\_Kroenert temporally\_precedes Popov\_v\_Hayashi.
- Pierson\_v\_Post is a decided\_case.
- Pierson\_v\_Post temporally\_precedes Popov\_v\_Hayashi.
- State\_v\_Shaw is a decided\_case.
- State\_v\_Shaw temporally\_precedes Popov\_v\_Hayashi.

Several queries that can be put to the knowledge base:

- What is Popov\_v\_Hayashi's case\_citation?
- What is Popov\_v\_Hayashi's case\_decision?
- What is Popov\_v\_Hayashi's case\_name?
- What is Popov\_v\_Hayashi's cause\_of\_action?
- What is Popov\_v\_Hayashi's fact?
- What is Popov\_v\_Hayashi's judge?
- What is Popov\_v\_Hayashi's known\_decision\_date?
- What is Popov\_v\_Hayashi's legal\_issue?
- What is Popov\_v\_Hayashi's plaintiff?
- What is Popov\_v\_Hayashi's video\_tape\_argument\_scheme?
- Who is Popov\_v\_Hayashi's expert\_witness?

## 5. Discussion

Early research has also identified some key elements for case base representation ([26], [27], [28] and [29]). More recently, there is work on ontologies for information retrieval for case based reasoning ([30] and [8]). The LOIS project derived a rich legal lexicon from a range of legal documents, however, case representation is not central ([31] and [32]). The Legal Knowledge Interchange Format (LKIF) focusses on abstract elements of legal knowledge, not including cases; there are points where LKIF and our proposal could be integrated ([33] and [34]). Recent proposals for case ontologies include [35], [36] and [8]. [35] primarily introduces bibliographic elements; the ontology of [36] must be inferred from the paper, does not relate to case based reasoning, and does not illustrate the richer range of elements we provide; [8] focuses on case based reasoning. Finally, we also incorporate into the ontology research on legal argumentation as in [1].

Our approach is *modular* in that distinct subcomponents of the ontology can be independently developed ([29], [8], [36]). We have noted in the presentation of the abstract ontology various ways in which elements can be added to the ontology. No doubt other components that are relevant to case law can be found. One way to proceed, as we have done, is to tie the development of the on-

tology closely to actual case decisions. In general, providing instantiated cases, preferably a well-known set of related cases, would test the current ontology and suggest modifications. One overall aspect which we have not addressed is the introduction of rules (beyond the usual class reasoning rules) to reason with the ontology and instantiations. Finally, while information retrieval and extraction are related to an ontology of cases, there are important differences. In particular, while an ontology represents systematic, general, abstract conceptualisations of the domain, it is infeasible to require an ontological representation for all aspects that might be found in a case. For this, information retrieval and extraction techniques would be required to identify relationships among the cases that are not overtly coded in the ontology.

In the future, we will develop and instantiate the ontology using web-based tools such as *Semantic Wikis* with rich markup features that are tied to an ontology as well as an online, collaborative ontology development tool such as WebProtégé. This will leverage the distributed power of a community of researchers, make the results open, and provide a fragment of a semantic web application in a legal case base domain. In all, much remains to be done in the area of ontological representation of and reasoning with cases.

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# Dimension Based representation of Popov v Hayashi<sup>1</sup>

Trevor Bench-Capon

Department of Computer Science  
University of Liverpool  
Liverpool L69 3BX UK  
{tbc}@csc.liv.ac.uk

**Abstract.** In this paper I consider Popov v Hayashi in the context of the well known wild animals cases, Pierson v Post, Keeble v Hickergill, Young v Hitchens and Ghen v Rich. Although there is no extensive discussion of these cases in the decision in Popov, Pierson and Young were cited in a footnote, and the cases are used in one of the leading commentaries. We will consider the extent to which Popov can be modelled in terms of the factors and dimensions that have been developed to represent the wild animals cases through a series of AI and Law papers, and offer a discussion drawing out some general lessons applicable to this style of case modelling.

## 1. Introduction

Since first introduced into AI and Law in [8], the wild animals cases of *Pierson v Post*, *Keeble v Hickergill*, and *Young v Hitchens* have become something of a standard example. Since [8] these cases have been discussed in [5], [16], [19], [4] and [3], and in several other papers. A few additional cases were introduced in [4], of which we will consider *Ghen v Rich* in this paper. The result of these investigations is that we have an analysis of the cases which can serve as basis for using case based reasoning in the style of HYPO [2] or CATO [1]. In what follows the reader is assumed to be aware of the basic characteristics of HYPO and CATO. In this paper we will see whether we can use these cases to shed light on *Popov v Hayashi*. Although this case was about the disputed possession of a baseball rather than a wild animal, there are definite analogies to be drawn. The wild animal cases were used in argument in *Popov*, and were an important part of the argument of Finkelman [12], which is a leading com-

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mentary of the issues in *Popov*. Briefly stated, the facts of the four wild animals cases are:

*Keeble v Hickergill* (1707). This was an English case in which Keeble owned a duck pond, to which he lured ducks, which he shot and sold for consumption. Hickergill, out of malice, scared the ducks away by firing guns. The court found for Keeble.

*Pierson v Post* (1805). In this New York case, Post was hunting a fox with hounds. Pierson intercepted the fox, killed it with a handy fence rail, and carried it off. The court found for Pierson.

*Young v Hitchens* (1844). In this English case, Young was a commercial fisherman who spread a net of 140 fathoms in open water. When the net was almost closed, Hitchens went through the gap, spread his net and caught the trapped fish. The case was decided for Hitchens.

*Ghen v Rich* (1881). In this Massachusetts case, Ghen was a whale hunter who harpooned a whale which subsequently was not reeled in, but was washed ashore. It was found by a man called Ellis, who sold it to Rich. According to the custom and practice of the whaling industry, Ellis should have reported his find, whereupon Ghen would have identified his lance and paid Ellis a fee. The court found for Ghen.

*Popov v Hayashi* (2002). This San Francisco case concerned the possession of the baseball which was struck to give Barry Bonds his record breaking 73rd home run in the 2001 season. Such a ball was thought likely to be very valuable (Mark McGwire's 1998 70th home run ball sold at auction for \$3,000,000). When the ball was struck into the crowd, Alex Popov caught it in the upper part of the webbing of his softball glove (fans often wear baseball gloves to assist in catching balls that leave the park). Such a catch, known as a snowcone catch where the ball is not fully in the mitt, does not give certainty of retaining control of the ball, particularly since Popov was stretching and may have fallen. Popov was not, however, given the chance to complete his catch since, as it entered his glove, he was tackled and thrown to the ground by others trying to secure the ball. In the ensuing scrum the ball was dislodged from the glove and picked up by Patrick Hayashi (himself innocent of the attack on Popov), who put it in his pocket, so securing possession. The incident was filmed on video by one Josh Keppel.

Popov has been previously modelled in [20], and that model was implemented as an answer set program in [11].

## 2. Factors and Dimensions

In [8], the authors argue that the factor based representation of CATO required augmentation to allow the motivation for the factors to be considered. This factors were to be associated with the purpose that considering them advances. Four factors were identified.

1. **NotCaught:** This factor applies if the plaintiff had not taken bodily possession of the quarry, and advances the purpose of promoting certainty through a clear definition of possession. It applies in all of the five cases. If applicable, it favours the defendant.
2. **Open/Owned:** This refers to the status of the land where the hunt was taking place, and advances the purpose of protecting property rights. Open land favours the defendant, owning the land favours the plaintiff. The land was open in all cases except *Keeble*, where the plaintiff owned the land.
3. **Livelihood:** This factor applies if the plaintiff is pursuing his livelihood, and advances the purpose of protecting valuable activities from interference. It applies in *Keeble*, *Young and Ghen*, and favours the plaintiff.
4. **Compete:** This factor applies if the defendant is in competition with the plaintiff, advances the purpose of protecting free enterprise and competition and favours the defendant. It applies in *Young*.

These factors have been used as the basis of the analysis in most of the subsequent work which has used factors, although purposes are often termed *values*, and the defendant pursuing his livelihood is often used instead of *compete*. Suppose we apply the factors to the new case of *Popov v Hayashi*. The only factor that applies is NotCaught. That Popov did not establish bodily possession was decided on the facts. But the land was neither open nor owned by either party, and neither *Popov* nor Hayashi were pursuing their livelihood. It could be argued that Hayashi was in competition with *Popov*, but that seems to stretch the meaning of the factor, which was originally intended to apply only where Livelihood was applicable. If this is so, it would seem that *Popov* is on all fours with *Pierson*, and there is little argument for the plaintiff.

But is this the only way to interpret the cases? In [4], the authors argued that the cases should be represented in terms not of the factors of CATO, but rather in terms of dimensions as in HYPO. They suggested replacing the factors by four dimensions:

1. **Possession:** This would range from the extreme pro–defendant position where the animal was roaming entirely free, through chase being started, hot pursuit, mortal wounding to the extreme pro–plaintiff position of actual bodily possession.
2. **Ownership:** This would range from the the extreme pro–defendant position where the defendant owns the land, through various looser tenures to open land, and then through various plaintiff tenures to the extreme pro–plaintiff position of the plaintiff owning the freehold.
3. **Motive:** Rather than simply focussing on whether the plaintiff was earning his livelihood, the suggestion here is that a range of increasingly worthy motives should be considered, starting from malice, through pleasure and social service to livelihood. Both the motive of the plaintiff and the defendant can be considered as separate dimensions.

This finer grained analysis allows us to make some distinctions between the various cases. Thus in *Pierson v Post*, Pierson was in hot pursuit, on open land, and both parties were pursuing the social purpose of exterminating vermin. In *Keeble*, the plaintiff had taken steps to attract the birds to his land, owned the land, and was acting from economic motives, whereas the defendant was acting out of malice. In *Young*, Young was on the point of capturing the fish, the land was open, and both were economically motivated. In *Ghen*, Ghen had harpooned the whale (considered enough to establish possession by the conventions of the whaling industry), the land was open and both were economically motivated. So we can arrange the cases on our dimensions in the following way (most pro–plaintiff first).

- **Possession** Ghen, Young, Keeble, Pierson
- **Ownership** Keeble, {Ghen, Young, Pierson}
- **PlaintiffMotive** {Ghen, Young, Keeble} Pierson
- **DefendantMotive** Keeble, Pierson, {Ghen, Young}

Where would we fit *Popov* on these dimensions? Possession is relatively straightforward: it is perhaps in this that the case is closest to *Young*, in that Popov was in pursuit of the ball and could reasonably be expected to catch it had he not been prevented from so doing by interference. Ownership is, however, not so straightforward. Neither owned the land, but neither was it public and open. On the other hand both had paid their admission money and so had every right to be there (and by the conventions of baseball to pursue and take possession of any baseballs that came their way). Their motives were economic, but not in the same way as the precedent cases. Under normal circumstances a baseball has little monetary value: it is desirable as a souvenir or a trophy, but not usually an object of contention. This special baseball did have value, but neither of the parties to the case were professional baseball hunters. Nor can their activity be said to be socially useful: if we take the purpose underlying the dimension seriously, it is debatable whether we would wish to encourage this activity. If we wanted to apply the analysis of [4], we should probably see *Young* as the most on–point, given the similarity of possession and ownership, and that both parties were acting from the same motive, wherever we choose to locate it on the dimension.

But should we simply apply these dimensions to *Popov*? Although these dimensions seemed to handle the cases for which they were designed relatively well, extending them to the new case of Popov casts some doubt on whether they are hitting all the most important issues. *Possession* seems fine, but there are a number of other questions. The dimension of *Ownership* seems to be covering at least two different aspects:

1. if the plaintiff owned the land, then the defendant might have been trespassing, and so engaged in an illegal act. This was not the case in *Keeble*, but was an issue in some past cases remarked on, but dismissed as not

pertinent, in the decision in *Pierson*. In *Keeble*, however, the defendant was committing an undoubted nuisance affecting Keeble's enjoyment of his property, and so was at least arguably acting illegally. So we might ask whether the interference involved an illegal act, creating another dimension, with the illegality not necessarily dependent on the ownership of the land. If we do this, however, we need also to consider whether it was the defendant who was responsible for the illegal act: in the *Popov* case the interference was an illegal assault on Alex Popov, but the assault was not committed by Hayashi.

2. if the plaintiff owns the land, then he may be considered to have a presumptive right to the animals found on it. This was the case in *Keeble*—indeed the ducks motivated his purchase of the land— but is not of relevance to *Popov*.

The point is that there are several aspects to property ownership, and it might be necessary to separate them out, so that issues of the defendant acting illegally are separate from the ownership rights over the animals conferred by ownership of the land. The second aspect can be represented by including the reason for possession in the *Possession* dimension, and we might propose some additional dimensions to handle the first aspect:

- **InterferenceIllegal.** This would run from the perfectly lawful (*Ghen*), through discourtesy (as in *Pierson and Young*), through nuisance (*Keeble*) and trespass, to assault (*Popov*).

The opinion in *Popov* makes some explicit reference to the illegality of the interference, and also makes it clear that the purpose of taking this into consideration is to discourage similar scenes in the future. We can see this factor as being considered in order to promote *public order*.

While this dimension would increasingly favour the plaintiff, we would also need a dimension to take account of the defendant's behaviour, since it would be unfair to disadvantage someone because an illegal act occurred, when they were not responsible for the illegal act.

- **DefendantBehaviour.** This would range from the defendant being entirely blameless, through discourtesy and malice to actual legal offences, increasingly favouring the plaintiff.

These two dimensions, and the additional points in possession, would replace *Ownership*.

We might also consider whether we need to be interested in the monetary value of the quarry. The fox was worthless (although in previous years there had been a bounty on foxes in the area [7]), whereas the other three animals had commercial value, as did this particular baseball. But really this explains why it was a matter considered worth pursuing through the courts, rather

than a feature which should influence the decision. The important aspect of the worth when considered in the previous cases lay in whether it a productive activity that we wish to encourage. If we think about things in this light, the value of the ball becomes irrelevant. Moreover, in the particular case of *Popov*, however, this is not a real issue since both parties were acting from the same motive. So we might add the dimension:

- **LaudableActivity:** this would range from activity to discourage, neutral, socially useful, economically valuable.

These three new dimensions could replace the two dimension referring to motive.

Considering our cases on the new dimensions we can rank them (from most pro-plaintiff to most pro-defendant):

- Possession: Ghen, Keeble, {Young, Popov}, Pierson
- InterferenceIllegal: Popov, Keeble, {Young, Pierson}, Ghen
- DefendantBehaviour: Keeble, {Young, Pierson}, {Ghen, Popov}
- LaudableActivity: {Ghen, Young, Keeble}, Pierson, Popov

If we consider the cases in terms of these dimensions, we might at first think that possession –now that it is acknowledged that it can arise not only through bodily seizure, but also through an industry-wide convention and ownership of land– as the only dimension to consider: this would be enough at least for the four animal cases. But Popov makes clear that the illegality of the interference also matters: it is clear from the decision that in the hypothetical situation where Hayashi had committed the assault, the verdict would have been for Popov. So the second and third dimensions do matter. The fourth perhaps seems less important, but was part of the dicta in *Keeble and Young*, and grounded the minority opinion in *Pierson*, and so perhaps should not be ignored: even though it is not necessary to deciding any of these five cases, it may take on a more important role in some future case.

### 3. Discussion

Thus far, we have seen that, applying the past analysis to *Popov v Hayashi*, we find that the factors based approach aligns the case with *Pierson*, and the dimensions approach with *Young*. Neither of these would be good news for Alex Popov, and on previous analysis he would have no way of distinguishing the cited cases. If, however, we consider the perspective just developed, Popov has a dimension on which *Young* can be distinguished: the interference was illegal. Although this was not something that the previous analyses recognised, it was a clear consideration of the judge in the Popov case. The decision is at pains to emphasise that Hayashi was not guilty of the assault on Popov, and considers

that Popov's appropriate redress would have been to sue his assailants, had it been possible to identify them. Thus we can see *Popov* as requiring us to modify the analysis to include this additional dimension.

We should perhaps not be too surprised that a new case can lead us to reinterpret existing cases. Case law should not be seen as a static body of knowledge, but as something which evolves and adapts. For example Levi [15] writes:

The movement of common or expert concepts into the law may be followed. The concept is suggested in arguing difference or similarity in a brief, but it wins no approval from the court. The idea achieves standing in society. It is suggested again to a court. The court this time reinterprets the prior case and in so doing adopts the rejected idea.

The adaptive nature of case law was explored in [13], where the authors considered how understanding of a case law domain would evolve differently depending on the sequence in which cases were presented.

Of course, this does have some implications for the use of systems such as HYPO and CATO: those systems presuppose that case law can be seen as a static body of analysis which can be applied to a new case without adaptation. How can we plausibly make the assumption of a static domain? First there is the nature of the domain. In Levi's model [15] a period of fluctuation and development is followed by a period of stability, in which the law seems to be well understood and settled. During this period, cases tend to retain a fixed interpretation. Eventually tensions will develop and this will break down, typically through a landmark case. That eventually a settled interpretation would break down was recognised, and signs that a change were imminent were discussed, in [9] and [18]. So one thing that HYPO and CATO require is that the law be in its period of stability. It is also necessary to recognise that any analysis will have a lifetime and then need revisiting when the understanding of the domain is changed by some landmark case. A second consideration is the granularity of the analysis. The more abstract the level of analysis, the more likely we are to be able to fit a new case into it. On the other hand, results using this coarser classification may be less reliable. The abstract factor hierarchy of CATO helps with this: one could hope that new aspects can be incorporated as leaves in the abstract factor hierarchy, while retaining the structure. This is made all the more likely in CATO, which deals with the domain of US Trade Secrets Law because, for that domain, the Restatement of Torts provides an authoritative high level set of abstract factors. This was used to structure the abstract factor hierarchy in [1], and explicitly as a 'logical model' in IBP [10]. Finally there is the precaution of basing the analysis on a sufficiently large number of cases: it was perhaps unrealistic to expect all the issues to be identified in the four cases we considered here.

## 4. Representation as Theory Construction

We can use the above discussion to consider the representation of *Popov v Ha-yashi* in the theory construction style of [6].

Following this methodology we must first identify a set of factors, the values they promote and the side they favour. In order to do this we will consider the dimensional analysis of section 2, and use the various points on these dimensions as factors. The side favoured will depend on how far they lie along the dimension, and the value will be taken from the purpose the dimension promotes. The factors are shown in Table 1. Only factors used in the five cases under consideration will be shown.

**Table 1: Factors**

FactorID	Factor	Value	Value ID	Party Favoured
HP	Hot Pursuit	Legal Certainty	LC	Defendant
OL	Owned land	Legal Certainty	LC	Plaintiff
C	Convention Applies	Legal Certainty	LC	Plaintiff
ID	Discourteous	Public Order	PO	Defendant
N	Nuisance	Public Order	PO	Plaintiff
A	Assault	Public Order	PO	Plaintiff
M	Malicious	Fairness	F	Plaintiff
DD	Discourteous	Fairness	F	Defendant
B	Blameless	Fairness	F	Defendant
EV	Economically Valuable	Laudable	L	Plaintiff
SV	Socially Valuable	Laudable	L	Defendant

Note that Discourtesy favours the defendant, as does socially valuable, even though they are things that would be put forward in the plaintiff's favour. This is to reflect that they were held insufficient to add weight to the plaintiff's case in *Young and Pierson* respectively.

We next assign the factors the five cases, and record their outcome.

- Keeble: {OL, N, M, EV}, Plaintiff
- Pierson: {HP, ID, DD, SV}, Defendant

- Young: {HP, ID, DD, EV}, Defendant
- Ghen: {C, B, EV}, Plaintiff
- Popov: {HP, A, B}, Undecided

Note that only one factor can be taken from a given dimension: in *Ghen*, for example, the convention makes the lack of bodily seizure irrelevant. Following the method of [6] we begin by constructing the simplest pro-defendant theory, citing Pierson:

## T1

**cases:** (Popov,(HP,A,B)), (Pierson, (HP, ID, B, SV)

**factors:** HP **rules:** HP Defendant

**rule prefs:**  $\emptyset$

**value prefs:**  $\emptyset$

At this point neither of the pro-plaintiff precedents are in fact useful to Popov – the only factor in common with *Young and Ghen* is that the defendant was doing nothing illegal, which favours the defendant. Thus Popov can only argue that the assault was enough to favour him, claiming a preference for PO over LC.

## T2

**cases:** (Popov,(HP,A,B)), (Pierson, (HP, ID, B, SV)

**factors:** HP, A

**rules:** HP Defendant, A Plaintiff

**rule prefs:** A Plaintiff > NC Defendant

**value prefs:** PO > LC

It seems that this value preference was accepted. But Hayashi still has a factor and so can construct a third theory:

## T3

**cases:** (Popov,(HP,A,B)), (Pierson, (HP, ID, B, SV)

**factors:** HP, A, B

**rules:** HP Defendant, A Plaintiff, B Plaintiff

**rule prefs:** A Plaintiff > NC Defendant,

B Defendant > A Plaintiff

**value prefs:** PO > HP, F > PO

If accepted, and the judge did identify fairness as his most important value, this would suggest a finding for Hayashi. But in the opinion, McCarthy seems

to construe the rule arising from the innocence of Hayashi differently, as something more like

$$B \rightarrow \neg \textit{Plaintiff},$$

or perhaps even more like

$$B \hookrightarrow \textit{Plaintiff},$$

where ‘ $\hookrightarrow$ ’ is to be construed as a *defeater* in the sense of Defeasible Logic (DL) (e.g. [14]), that is a rule which blocks a conclusion, while not licensing the negation of that conclusion. This is interesting behaviour on the part of McCarthy, and may lend support to those who have argued that a logic like DL is more appropriate to legal reasoning than classical logic. We should, however, be wary of drawing this conclusion too quickly: B also applies in Ghen, where the case was decided for the plaintiff, and we would probably not wish to infer  $LC > F$  from that case simply in order to be able to ignore the defeater. B takes on this role only when the inferences was illegal, so perhaps the rule used by McCarthy is rather

$$A \wedge B \hookrightarrow \textit{Plaintiff}.$$

Note that we do not want the rule to be

$$A \wedge B \rightarrow \neg (A \rightarrow \textit{Plaintiff}).$$

since we still need to use

$$A \rightarrow \textit{Plaintiff},$$

to prevent a finding for Hayashi. Perhaps McCarthy’s rule is best expressed as

$$A \wedge B \rightarrow ((B \hookrightarrow \textit{Plaintiff}) \wedge A (\hookrightarrow \textit{Defendant})).$$

If this discussion is correct, and if McCarthy’s position is a reasonable example of legal reasoning, then there are implications for approaches such as [6], and perhaps also for any factor based approach. First it seems difficult to capture McCarthy’s understanding of the rule he is applying in terms of classical logic, which means that something more sophisticated than the simple logic used by [6] is required. Secondly although some factors do behave in this way, others do not, and so factors can no longer be seen as homogeneous, and do not relate to rules in the straightforward way proposed by [17] and adopted by [6]. Moreover, one might consider whether this apparent heterogeneity of factors needs to be accommodated in CATO style approaches also. In the previous model of Popov [20], the problem is resolved by the use of arguments justifying refraining from an action: thus the answer set implementation of [11] finds justified arguments to not find for Popov and to not find for Hayashi. In that work these arguments are instantiations of an argumentation scheme for practical reasoning and so no logic is explicitly used, but, if we were to render them using a logic, some mechanism such as the defeater of DL would seem necessary.

## 5. Conclusion

The above discussion has been intended to draw out a number of points relating to case representation:

1. That new cases may require us to reinterpret our analysis of precedent cases, throwing new light on how we should identify factors.
2. In consequence, systems such as HYPO and CATO, which presuppose an existing analysis, can best be applied in domains in which the case law is regarded as stable and relatively well understood.
3. That the granularity of the analysis needs to be sufficiently fine if blurring important distinctions is to be avoided.
4. That it is possible that that theories should be seen in terms of some non-classical logic such as DL rather than in terms of classical logic, so that the notion of defeaters can be captured.

The last point would require further substantiation before becoming a firm conclusion, but some sort of non-classical understanding is certainly is required to understand McCarthy's decision in the *Popov* case.

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# Towards Computational Modelling of Supreme Court Opinions: *Furman v Georgia*<sup>1</sup>

Trevor Bench-Capon

Department of Computer Science  
University of Liverpool  
Liverpool L69 3BX UK  
{tbc}@csc.liv.ac.uk

**Abstract.** Cases can be modelled at many different levels. Supreme Court opinions have offered a challenge to computational case modelling in AI and Law since its very beginnings. In this paper the modelling of the nine opinions in the Supreme Court decision on *Furman v Georgia* is discussed from a computational argumentation perspective. The opinions are summarised and the modelling of the arguments they contain are considered from the perspective of two approaches: argumentation schemes for justifying actions and critical questions, and case based reasoning using precedents represented in terms of dimensions and factors. This analysis both reveals the extent to which applicable techniques exist and opens up directions for future investigation.

## 1. Introduction

One of the very first problems to be addressed in Artificial Intelligence and Law was the modelling of Supreme Court Opinions. The TAXMAN project of McCarty and Sridharan set itself the goal of computationally reproducing the majority and minority opinions in the celebrated taxation case of *Eisner v Macomber* [13]. Although McCarty was never entirely successful in achieving this end, (see [12] for the last in his line of papers on the topic), it stimulated a lot of valuable research as techniques to address the various problems were devised. The problem of modelling Supreme Court opinions therefore remains as a challenge for those who wish to model natural argumentation in general and legal argumentation in particular.

Since [12] there has been a good deal of development in computational argumentation, and so now is perhaps a good time to see to what extent these

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new techniques have brought us closer to this goal, and to identify particular problems that still require solution.

In the next section I shall describe the case that I will attempt to represent: *Furman v Georgia* 408 U.S. 238 (1972). This was an exceptionally important case, which temporarily halted capital punishment in the USA as a ‘cruel and unusual’ punishment prohibited as unconstitutional under the 8th and 14th Amendments. The importance of the decision is reflected in the fact that all nine of the Justices chose to issue their opinion, rather than, as is more usual, joining in an opinion authored by a representative of their point of view. In section 3 I shall consider the extent to which these opinions can be modelled using current computational argumentation techniques. From this I shall identify some open problems which require attention.

Two caveats should be stated. I will not address any issues of natural language, but will be solely concerned with the structure of the arguments: the aim is a system which reasons like a lawyer, not one which writes like one. Second, I shall not always address issues of where the knowledge might come from: here we are concerned with whether there is a computational approach which would enable the arguments to be produced if the required knowledge were to be suitably represented. An interesting evaluation would, however, be to assume that the knowledge required for *Furman* is available and then to use the facts of *Gregg v Georgia* 428 U.S. 153 1976, to see whether the opinions in that case (also concerned with capital punishment, heard before eight of the Justices from *Furman*, and effectively permitting capital punishment in the USA subject to some constraints) could be reproduced. I will offer some remarks on this in section 4.

## 2. *Furman v Georgia*

The full text of the opinions can be found at <http://www.law.cornell.edu>. Quotations from the opinions will be referenced by the name of the relevant Justice, where it is not clear from the context. The facts of the case are quite straightforward:

The victim surprised Furman in the act of burglarizing the victim’s home in the middle of the night. While escaping, Furman killed the victim with one pistol shot fired through the closed kitchen door from the outside. (Marshall, footnote 48.)

That Furman was guilty of murder was not disputed. Under Georgia law a person found guilty of this kind of homicide could be sentenced to death or to life imprisonment, according to the decision of the jury. The members of the jury were given no guidelines, but left entirely to their own judgement and discretion. The question before the Supreme Court was:

Does the imposition and carrying out of the death penalty in [these cases<sup>2</sup>] constitute cruel and unusual punishment in violation of the Eighth and Fourteenth Amendments? (*Furman v Georgia*, Syllabus).

Nine Justices heard the case and all delivered separate opinions. Table 1 shows the judges, the year in which they were appointed (interestingly and perhaps significantly, the five concurring justices had all served under the Chief Justice Earl Warren, while the four dissenting justices had been appointed to the court after Warren's retirement) and the length in A4 pages of their opinions.

**Table 1: Justices in *Furman v Georgia***

Justice	Decision	Year Appointed	Pages
Warren Earl Burger	Dissenting	1969	17
Harry Blackmun	Dissenting	1970	6
William J Brennan	Concurring	1956	32
William O Douglas	Concurring	1939	13
Thurgood Marshall	Concurring	1967	40
Lewis F Powell	Dissenting	1972	29
William Rhenquist	Dissenting	1972	4
Potter Stewart	Concurring	1958	4
Byron White	Concurring	1962	3

As can be seen from Table 1, the Justices split 5-4. The grounds of the majority differed: Brennan and Marshall were certainly of the opinion that the death penalty was in itself cruel and unusual in all circumstances. Arguably, Douglas was also of this view. Stewart and White, however, stopped short of this, although they held that, as embodied in the laws of Georgia at the time, it was cruel and unusual. This led to a large number of states (including Georgia) producing revised legislation authorising the death penalty. The new legislation was to be tested and upheld in *Gregg v Georgia*, heard by the same Justices, except that Douglas had been replaced by John Paul Stevens. *Gregg* was decided 7-2 with Brennan and Marshall dissenting.

The decisions also vary greatly in length. Several of them contain lengthy periods of historical exegesis. Clearly here I will have to omit much of this. Instead I shall try to give the essence of the arguments on which the opinions are based. These summaries are mine, and might involve some interpreta-

<sup>2</sup> Two other cases were also under consideration at the same time. We will not need to refer to them further in this paper.

tion. Nonetheless they set a sufficiently difficult target for a system intended to reproduce the reasoning.

## 2.1. Brennan

Brennan begins by attempting to dispose of three possible arguments against his view, which will be that capital punishment should be considered cruel and unusual in the sense of the 8th Amendment.

First, that since the Framers of the Amendment accepted capital punishment, they could not have intended it to be prohibited as cruel and unusual. Brennan argues that the possibility of future prohibition of capital punishment had been considered since it was explicitly raised in the debate, and that since it is essentially a moral judgement it must reflect ‘the evolving standards of decency that mark the progress of a maturing society’ (a principle enunciated in *Trop v. Dulles*, 356 U.S. (1958)). For example flogging and ear cropping had been available legal penalties when the amendment was passed, but are no longer socially acceptable, and would be considered cruel and unusual even though the Framers would not have found them objectionable.

Second, that it is for the legislators to express what is acceptable in society. Brennan argues that intention of the amendment could only have been to place a check on what could be enacted and that it showed that there was a desire to avoid having to rely entirely on the virtue of representatives.

Third that the issue has already been decided by the Supreme Court (as recently as the previous year, a sentence of death had been upheld in *McGautha v. California*, 402 U.S. 183, 196–208 (1971)), and therefore the issue was already settled according to the doctrine of *stare decisis*, whereby precedents bind future decisions. Here Brennan argues that although there had previously been remarks on the topic, the issue had never been directly considered before:

The constitutionality of death itself under the Cruel and Unusual Punishments Clause is before this Court for the first time; we cannot avoid the question by recalling past cases that never directly considered it. (Brennan)

Brennan does not specifically address the most recent precedent of *McGrautha* – a decision from which he, with Marshall and Douglas had dissented – but that case was argued in terms of the 14th Amendment rather than the 8th, and turned on the lack of guidance given to the jury in choosing between death and life imprisonment, and so did not raise the issue of ‘constitutionality of death itself under the Cruel and Unusual Punishments Clause’.

Having established that the Court is able to decide the issue and is not constrained by either a narrow historic interpretation or precedent, Brennan

proposes a test on which he will base his positive argument. There are essentially four principles (indicated by my emphasis):

the cumulative test to which [these considerations] lead: it is a *denial of human dignity* for the State *arbitrarily* to subject a person to an unusually severe punishment that *society has indicated it does not regard as acceptable*, and that *cannot be shown to serve any penal purpose more effectively* than a significantly less drastic punishment. (Brennan)

Note that the four principles yield a *cumulative* test: none are intended to be sufficient or necessary, but each lends its own weight to the reasons for the decision, and jointly this weight may suffice. He then gives his reasons for thinking that each of the four principles are, to some extent at least, satisfied:

- Capital punishment is uniquely degrading because it is a denial of the victim's humanity.
- It is arbitrary because it is rarely imposed even when available, and there is no suggestion that it is reserved for the worst offences:

If, for example, petitioner Furman or his crime illustrates the 'extreme', then nearly all murderers and their murders are also 'extreme'. (Brennan).

- The fact that juries rarely apply the penalty is an indicator that is no longer socially acceptable
- Life imprisonment would serve as well as an available, but rarely imposed, death penalty for the purposes of prevention, deterrence and the expression of outrage at the crime.

Brennan believes his arguments to establish each of the principles to some extent, as indicated below (italics mine):

In sum, the punishment of death is inconsistent with all four principles: death *is* an unusually severe and degrading punishment; there is a *strong probability* that it is inflicted arbitrarily; its rejection by contemporary society is *virtually total*; and there is *no reason to believe* that it serves any penal purpose more effectively than the less severe punishment of imprisonment. The function of these principles is to enable a court to determine whether a punishment comports with human dignity. Death, quite simply, does not. (Brennan).

My assessment is that he is on reasonably strong ground with the first two, has a rather weak (and overstated) argument for the third, and that he has shown that there is perhaps no conclusive argument either way on the fourth.

## 2.2. Marshall

Marshall also begins with a lengthy historical discussion intended to show that the Court has the obligation to restrain legislatures which attempt to impose any 'punishments which, by their excessive length or severity, are greatly disproportioned to the offences charged.' and that there is no governing precedent:

There is no holding directly in point, and the very nature of the Eighth Amendment would dictate that, unless a very recent decision existed, *stare decisis* would bow to changing values (Marshall)

Of course, the difficulty for this is that there are recent precedents: *Trop* in 1959 and *McGautha* in 1971. Marshall, however, argues that fifteen years is not recent ('*Trop v. Dulles* is nearly 15 years old now, and 15 years change many minds about many things'), and that the issue of the general constitutionality of the death penalty was actually excluded from direct consideration in *McGautha*, which turned on the correct application of procedures. As noted above, Marshall had been amongst the dissenters in *Mc-Gautha*.

For his positive argument Marshall proposes a two fold test, with either principle intended to be sufficient (emphasis mine).

since capital punishment is not a recent phenomenon, if it violates the Constitution, it does so because it is *excessive or unnecessary*, or because it is *abhorrent to currently existing moral values*.

Marshall then gives six possible reasons why capital punishment might be thought necessary: retribution, deterrence, prevention of repetitive criminal acts, encouragement of guilty pleas and confessions, eugenics, and economy. He dismisses retribution as a legitimate goal of punishment, arguing that it may explain punishments but it cannot be used to justify them. He also dismisses eugenics as an illegitimate motivation. He argues that execution is more expensive than imprisonment, and that the other goals of deterrence, prevention and justice can be served equally well by life imprisonment.

In arguing that capital punishment is also socially abhorrent, Marshall recognises that he is on weak ground since probably a majority of the population would, given the opportunity, vote to retain capital punishment. He therefore argues that

In other words, the question with which we must deal is not whether a substantial proportion of American citizens would today, if polled, opine that capital punishment is barbarously cruel, but whether they would find it to be so in the light of all information presently available. (Marshall).

His argument is that people are generally ill-informed on the subject, but were they aware of such facts as that capital punishment has no greater deterrent effect than imprisonment, that it is rarely imposed, and imposed in a discriminatory way, has been erroneously imposed and the like, they would find it morally objectionable.

Assessing Marshall's arguments, we can accept that he himself believes that 'a punishment no longer consistent with our own selfrespect' (quoting a debate in the UK, where capital punishment was abolished in 1965), and that he cannot understand why anyone should, if in possession of the facts, disagree. But the evidence does not seem to bear this out. On the other hand, showing that it is excessive and unnecessary is enough, in terms of the task he set himself, and he has some reasonably strong arguments for this point<sup>3</sup>.

### 2.3. Douglas

Douglas first says that any remarks in previous decisions are not binding, since the meaning of 'cruel and unusual' may change as public opinion becomes more enlightened. His main focus is on the discriminatory impact of the death penalty:

It would seem to be incontestable that the death penalty inflicted on one defendant is 'unusual' if it discriminates against him by reason of his race, religion, wealth, social position, or class, or if it is imposed under a procedure that gives room for the play of such prejudices.

He then provides evidence that the death penalty is disproportionately imposed on the young, the poor, the ignorant, the black and males. He says

A law that stated that anyone making more than \$50,000 would be exempt from the death penalty would plainly fall, as would a law that in terms said that blacks, those who never went beyond the fifth grade in school, those who made less than \$3,000 a year, or those who were unpopular or unstable should be the only people executed. A law which, in the overall view, reaches that result in practice has no more sanctity than a law which in terms provides the same.

Since, according to Douglas, this is the effect of Georgia's law leaving sentence to the discretion of the jury, it is unconstitutional.

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<sup>3</sup> Although the logic of his test suggests that Marshall need only show one of the two disjuncts, both might be seen as necessary to justify the court going against the apparent will of the people as expressed by the legislature.

#### 2.4. White

In White's short decision he makes two points. First that while the death penalty could be justified by reference to social ends, these ends cannot be promoted when it is not mandatory and in practice rarely applied. Second that since the penalty is not mandatory, the legislature would be content were it never in practice applied and so striking it down cannot be said to frustrate the legislative will.

#### 2.5. Stewart

Stewart similarly sees a problem with leaving the decision as to whether the death penalty should be applied to the discretion of a jury: if the legislature had held it necessary for retribution, it should have made it mandatory, and not have created a situation in which it might never be imposed. He then argues that since it is so infrequently and capriciously imposed in practice, it is as unusual as being struck by lightning:

I simply conclude that the Eighth and Fourteenth Amendments cannot tolerate the infliction of a sentence of death under legal systems that permit this unique penalty to be so wantonly and so freakishly imposed.

Stewart may have overstated the rarity of the punishment, but the capricious nature of its imposition, licensed under the provisions of the law, would seem to be enough for his argument.

#### 2.6. Burger

We now turn to the dissenting opinions, starting with the Chief Justice, Warren Burger.

Burger first argues that the widespread use of the death penalty shows that it has not in the past been seen as impermissibly cruel. To accept that public opinion had changed would require compelling and unambiguous evidence which does not exist. Secondly it is for the legislature to judge whether it is necessary, and the legislation indicates that they do believe its availability is necessary, possibly for retribution which, Burger states, is a valid purpose. He denies that it is proven that juries act arbitrarily: on the contrary the 1971 decision in *McGautha* stated

In light of history, experience, and the present limitations of human knowledge, we find it quite impossible to say that committing to the untrammelled discretion of the jury the power to pronounce life or death in capital cases is offensive to anything in the Constitution.

Burger's view is that this recent decision is enough to dismiss the argument that jury discretion is inappropriate: even though he admits that it would be possible to disagree with the decision in *Mc-Gautha*, *stare decisis* must prevail. Finally he remarks that a return to mandatory imposition of the death sentence would be a backward step:

the 19th century movement away from mandatory death sentences marked an enlightened introduction of flexibility into the sentencing process. It recognized that individual culpability is not always measured by the category of the crime committed. This change in sentencing practice was greeted by the Court as a humanizing development.

Burger thus addresses all four aspects of Brennan's proposed test: he denies that capital punishment is in itself a denial of human dignity, denies that jury discretion means that its imposition is arbitrary, requires very much more conclusive evidence that popular opinion has changed, and considers judgement as to whether it needed or not to be outside the remit of the Court.

## 2.7. Powell

In the other substantial dissent, Powell begins by saying that precedent is unanimously in favour of the constitutionality of capital punishment:

On virtually every occasion that any opinion has touched on the question of the constitutionality of the death penalty, it has been asserted affirmatively, or tacitly assumed, that the Constitution does not prohibit the penalty. ... *Stare decisis*, if it is a doctrine founded on principle, surely applies where there exists a long line of cases endorsing or necessarily assuming the validity of a particular matter of constitutional interpretation.

For Powell, therefore *stare decisis* is not restricted to the direct questions before the Court. He then denies that jury discretion can be seen as arbitrary, citing *McGautha*. On the necessity issue he says that retribution is a purpose best served by capital punishment. He argues that disproportionality might be argued in a particular case, but not in general. Throughout he emphasises the broad sweep of the impact of the decision and the consequent heavy burden of proof need to overcome judicial restraint.

## 2.8. Blackmun

Blackmun states that the legislative will has been clearly shown in a number of recent measures authorising the death penalty for various offences overwhelmingly approved by Senate in the previous decade, and that decisions of

the Court had repeatedly affirmed its constitutionality. He indicates that he is personally supportive of arguments against capital punishment, and would vote against it as a legislator, but not as a judge:

I do not sit on these cases, however, as a legislator, responsive, at least in part, to the will of constituents. Our task here, as must so frequently be emphasized and re-emphasized, is to pass upon the constitutionality of legislation that has been enacted and that is challenged. This is the sole task for judges. We should not allow our personal preferences as to the wisdom of legislative and congressional action, or our distaste for such action, to guide our judicial decision in cases such as these.

### 2.9. Rehnquist

Rehnquist states first that capital punishment had always been thought necessary by the nation's legislators. He then says that judicial restraint requires that the legislative will be deferred to, especially since the consequences of wrongly denying an individual his rights are less severe than wrongfully frustrating the will of an elected body of legislators. He says:

While overreaching by the Legislative and Executive Branches may result in the sacrifice of individual protections that the Constitution was designed to secure against action of the State, judicial overreaching may result in sacrifice of the equally important right of the people to govern themselves.

Although he says 'equally important', from the context of his opinion (and his subsequent career), it is clear that he regards the latter as more important.

## 3. Representing the arguments

We have now seen the varied and sometimes ingenious arguments presented by the Justices in their opinions. We now turn to consideration of how such argumentation might be modelled. It is clear that the Justices go beyond questions of fact, and take considerable account of values: they need to consider 'the evolving standards of decency that mark the progress of a maturing society' (Trop), and recognise that on occasion 'stare decisis would bow to changing values' (Marshall) and 'The standard of extreme cruelty is not merely descriptive, but necessarily embodies a moral judgment' (Burger). For our notion of computational argument based on values we will first draw on the work of Atkinson, Bench-Capon and colleagues, as found in [6], [4] and [5], which have specifically considered arguments which use values to justify actions. The argumentation scheme and critical questions are formally defined in [4] in terms of

Action-Based Alternating Transition Systems [22], and has been implemented for reasoning about a moral dilemma [10]. For our present purposes we shall use a simplified version of the argument scheme developed in those papers. Essentially we will combine the action and the goal, to reflect that the relevant action is legislating to achieve a state of affairs.

**Suff** In the current circumstances, we should legislate so that X is the case, to promote the following values.

This scheme, like that of [4] is based on the *sufficient condition scheme for practical reasoning* given in [20]. There is a similar scheme to reflect that an action can be necessary to achieve the goal:

**Nec** In the current circumstances, we must legislate so that X is the case, if we are to promote the following values.

There is also a negative version arguing against a legislative act:

**Neg** In the current circumstances, we must not legislate so that X is the case, since this would demote the following values.

### 3.1. Practical Reasoning in The Concurring Decisions

Now we can presume that the legislature of the State of Georgia, in passing their capital punishment legislation must have accepted some argument such as CP1, instantiating **Suff**, using values taken from Marshall:

**CP1** Where capital punishment is socially acceptable, we should legislate so that the capital punishment is available, which promotes retribution, deterrence, prevention of repetitive criminal acts, encouragement of guilty pleas and confessions, eugenics, and economy.

The approach of [4] now identifies counter arguments through posing critical questions characteristic of the argument scheme. There are seventeen possible critical questions identified in [4]: we will use five of them here, numbering them as in that paper.

**CQ1** Do the current circumstances hold?

**CQ4** Does the action realise the value?

**CQ7** Are there alternative ways of realising the value?

**CQ9** Does the action demote some other value?

**CQ16** Is the value a legitimate value?

We can now use these critical questions to produce some of the arguments proposed by Marshall:

- M1** Capital punishment is not socially acceptable (**CQ1**)
- M2** Capital punishment is not less expensive (and so does not realise the value of economy) (**CQ1**)
- M3** Life imprisonment is as effective a deterrent (**CQ7**)
- M4** Life imprisonment is as effective for preventing repetitive criminal acts (**CQ7**)
- M5** Life imprisonment is as effective for encouraging guilty pleas (**CQ7**)
- M6** Retribution is not a legitimate value (**CQ16**)
- M7** Eugenics is not a legitimate value (**CQ16**)
- M8** Capital punishment demotes proportionality, since it is more severe than is necessary (**CQ9**).

Brennan had a fourfold test: two of these, social acceptability and no penal purpose more effectively served, essentially reproduce Marshall's arguments (M1 and M3-5), although his list of penal purposes is less complete. One of other two tests, relating to human dignity can also be represented in terms of CQ9

**BR1** Capital punishment demotes human dignity

Arbitrariness is a different matter, since this does not strike at capital punishment itself, but rather the particular arrangements provided in Georgia. Since Brennan links arbitrariness to human dignity, we can see this as an instantiation of **Neg**:

**BR2** In a free society, we should not permit severe punishments to be imposed arbitrarily, since this demotes human dignity.

with the additional assumption that a provision in which the sentence is determined at the discretion of juries permits arbitrary infliction of the death sentence.

**BR3** If sentences are determined at the discretion of juries they may be imposed in an arbitrary fashion.

Douglas proposes a similar argument, except he talks in terms of discrimination rather than arbitrariness and claims that discrimination is revealed in practice and puts forward the value of fairness, saying: 'It is unfair to inflict unequal penalties on equally guilty parties'.

**D1** In a free society, we should not permit severe punishments to be imposed in a discriminatory manner, since this demotes fairness.

**D2** Capital punishment is imposed disproportionately of the poor, young, black and male, and so is imposed in a discriminatory fashion.

Stewart also seems, with his use of ‘capricious’ and ‘freakishly rare’ and his analogy with being struck by lightning to be relying on fairness, but here it is rarity rather than arbitrariness or discrimination that he uses as premise:

**S1** In a free society, we should not permit severe punishments to be imposed very occasionally, since this demotes fairness.

White makes use of CQ4:

**W1** Availability of capital punishment will only promote the social values if it is regularly imposed, and it is not

He also points out that legislative will is not frustrated if capital punishment is never imposed, emphasising that the legislative will only covered availability, and this is insufficient to achieve its values.

From the above sketch it seems that the approach of using an argument scheme for practical reasoning with values and critical questions as in [4] can go quite a long way to producing the gist of the most important arguments in the concurring opinions. There are some additional arguments in Brennan and Marshall, which we will return to after considering the dissenting opinions.

### 3.2. The Dissenting Decisions

Turning now to the dissenting opinions, we first note that their task is rather different, in that they are arguing that the status quo should be maintained, and that the Georgia legislature was justified in accepting CP1. Therefore the onus on them is lighter: the legislature is presumed to have behaved constitutionally, so it is the consenting decisions that have to present decisive arguments that they have not done so in this case. A starting point for the arguments of the dissenting Justices can therefore be best approached as a critique of the arguments put forward by the concurring Justices. Thus Burger begins by affirming that capital punishment cannot be said to be socially unacceptable, since it had been common and widespread in the past, and there was no reason to suppose that there had been any dramatic shift in public opinion. Effectively this denies M1 and, by implication, BR1, as it states that capital punishment has never been thought to demote human dignity to an unacceptable extent. M2, M4 and M5 are ignored, since Burger has no wish to argue for these values. He does, however, take issue with M6, saying that ‘the Court has consistently assumed that retribution is a legitimate dimension of the punishment of crimes. Furthermore, responsible legal thinkers of widely varying persuasions have debated the sociological and philosophical aspects of the retribution question for generations, neither side being able to convince the other’. This can be seen as attacking M8 by arguing that capital punish-

ment is necessary to promote this value. On the question of arbitrariness he again states disagreement that discretion inevitably leads to arbitrariness and says that the practice was upheld in the 1971 decision in *McGautha*. This expresses that he has not been persuaded by BR3 or D2 and so does not accept BR2 or D1. Finally he says that it is for the legislature not the Court to decide which social ends it wishes to pursue and what is effective for those social ends, and so CQ4, CQ7 and CQ9 have to be posed in the context of a debate on legislation and are not available to the Court. This challenges M3-5 and W1.

We can summarise Burger's arguments as

**BU1** Capital punishment is presumptively socially acceptable, and there is not reason to think otherwise

**BU2** Retribution is a legitimate value

**BU3** Punishment imposed at the discretion of the jury is not imposed arbitrarily

**BU4** CQ4, CQ7 and CQ9 cannot be posed by the Court

**BU5** Capital punishment is necessary to promote retribution.

**BU6** Capital punishment does not demote human dignity.

Powell explicitly agrees with BU2, BU3 and BU4. The main feature of his decision is a lengthy discussion of previous decisions to establish BU1, and a claim that *stare decisis* means that the issue is already settled. We will consider the use of previous decisions in a later subsection. Blackmun bases his opinion on BU4, and on BU1, supported by a list of recent legislation authorising the death penalty. Rehnquist also advances BU1, but has an additional argument that in a conflict between the rights of an individual and State rights, State rights should prevail. Here we have an explicit value preference, and an example of **Suff** directed at the court. R1 is posed hypothetically, to stand for the views of the concurring Justices, and will be defeated by R2 together with R3.

**R1** In the current case, we should strike down the death penalty to promote individual rights (**Suff**)

**R2** Striking down the death penalty would demote state rights (**CQ9**)

**R3** State rights take precedence over individual rights

### 3.3. Use of Precedents

We now turn to arguments based on precedent cases, which has long been a central topic in Artificial Intelligence and Law. Probably the most highly regarded work is the tradition of HYPO and CATO, developed by Rissland, Ashley [3] and Alevén [1]. In this approach cases are represented as collections of factors which favour one decision or the other, and arguments are based on the presence or absence of factors in the current case with their presence or absence in precedent

cases and the outcomes of those cases. In CATO factors are either present or absent, but in HYPO, where they are called dimensions, they can be present to varying to degrees, lending more or less support to the side they favour.

Brennan says that a decision that a punishment was cruel and unusual had been taken in three previous cases.

Since the Bill of Rights was adopted, this Court has adjudged only three punishments to be within the prohibition of the Clause. See *Weems v. United States*, 217 U.S. 349 (1910) (12 years in chains at hard and painful labor); *Trop v. Dulles*, 356 U.S. 86 (1958) (expatriation); *Robinson v. California*, 370 U.S. 660 (1962) (imprisonment for narcotics addiction).

The four principles in his test are substantially equivalent to four dimensions which can favour the plaintiff in these cases. His cumulative test therefore could be seen as an application of the HYPO method to the current case, assuming that an appropriate analysis of the precedents existed. In particular the way he uses the test once found, with none of the principles being necessary or sufficient, individually or collectively, and all taken as established to a greater or lesser extent, is very much in accord with this approach. In the course of his opinion he effectively analyses the case in the same way as a knowledge engineer building a HYPO system for this domain would. This is an interesting relationship to the computational model, but is not itself a process which is currently computational.

Powell on the other hand does not reason with cases in this style. Rather he cites a string of decisions which have accepted capital punishment, although the issue was not whether capital punishment was cruel and unusual (note that none of Brennan's cases concerned capital punishment). Again this is essentially a knowledge engineering activity: Powell is examining decisions and extracting principles from them, independently of the question to which they relate. This is something like the approach used in some expert representations of case law such as [18] and [19]. Again existing computational applications use, rather than perform, the analysis. We can, however, say that from an AI and Law perspective, Brennan's use of precedent is akin to the case based style of HYPO, whereas Powell's resembles more the rule based expert system style. Marshall, understandably, endorses the narrower interpretation of *stare decisis* of Brennan's approach.

### 3.4. Summary of Representations

We can now take stock and consider what is agreed and what is disputed in the opinions. This is shown in Table 2. Some matters, discussed only by one Justice and not relevant to the outcome (such as the eugenics question) are omitted.

Resolving these disputes requires a consideration of the supporting evidence. In particular we should consider how the state of the art in computational modelling of argumentation accommodates the supporting arguments required.

*Capital punishment is socially unacceptable*: Brennan uses the infrequency with which juries impose the penalty. This is an example of a statistical syllogism, but the conclusion follows only tentatively. This does not matter too much for Brennan, assuming him to be using HYPO style reasoning since it serves only to place it at a relatively low point of the dimension. Marshall offers some appeal to an ideal well informed audience. It is difficult to see how this might be handled computationally except as a meta statement about some argumentation framework containing all relevant arguments to the effect that the conclusion was sceptically and objectively acceptable [6]. On the other side, there are facts relating to dicta in previous opinions, to recent legislative acts and to opinion polls to say that the position is, at least, not proven.

**Table 2: Agreed and Disputed Information**

Information	Status	Pro	Con
Court can reflect changing standards	Agreed		
Capital punishment is socially unacceptable	Disputed	M, BR	BU,P, BL
Capital punishment is a deterrent	Agreed		
Life Imprisonment is a deterrent	Agreed		
Retribution is not a legitimate value	Disputed	M, BR	BU, P
Capital punishment is more severe than is necessary	Disputed	M	BU, P, BL, R
Arbitrary punishments demote human dignity	Uncontested	BR	
Arbitrary punishments are discriminatory	Uncontested	D	
Punishments only occasionally imposed demote fairness	Uncontested	S	
Punishments only occasionally do not realise social values	Uncontested	W	
There are four relevant factors	Uncontested	BR	
Jury discretion means arbitrary sentences	Disputed	BR, S, W	BU, P
CQ4, CQ7 and CQ9 can only be posed by the legislature	Disputed	M, BR, W	BU, P, BL, R
State rights are to be preferred to individual rights	Disputed	M, BR	R

*Retribution is not a value.* This is a matter which belongs to the problem formulation stage of practical reasoning as conceived in [4]. There is, however, little or no discussion there (or elsewhere) on how arguments about whether or not something is, or should be, a value can be resolved.

*Capital punishment is more severe than is necessary.* While there is complete agreement that capital punishment is more severe than the alternatives, the necessity of this extra severity being available is disputed. Arguments adduced here turn on comparative studies of jurisdictions with and without the death penalty, and particularly focus on its necessity for deterrence. The dispute is also complicated by the degree of certainty to which this needs to be established: Marshall thinks that it is enough if it cannot be shown to be necessary; Brennan, with his cumulative test, need it to be shown unnecessary to some extent, whereas the dissenting Justices require clear, objective evidence that it is unnecessary. Notion of standards of proof have received some attention, e.g. [11], but there the focus was on the impact of different standards of proof, not how the appropriate standards of proof are chosen.

*Jury discretion leads to arbitrary sentences.* Those who would argue this must provide a reason to overcome the decision in *Mc-Gautha*, which on a natural reading seems to uphold jury discretion. Douglas attempts to demonstrate that discretion leads to arbitrary behaviour, by attempting to show that the discretion is exercised so as to produce discriminatory results. This is contested by Powell, who says that this apparent effect is ‘a tragic byproduct of social and economic deprivation’, but not evidence of discrimination. Again the degree to which the proposition must be established is also a matter of dispute.

*Certain critical questions can be posed only by the legislature.* This is a very interesting dispute, since it concerns the protocols under which a dispute might be conducted. While computational modelling recognises the importance of protocols and that different protocols may be appropriate for different purposes, there is no work which suggests how we might model arguments about which protocol should be used.

*State rights should be preferred.* This is also a dispute relating to values, but this time it accepts that both the values are legitimate and instead concerns which of them should be preferred. Some work on this has been done, (e.g. [7]), but this has mainly taken the form of exploring the consequences of a particular preference in an argumentation framework in order to show that it would result in accepting arguments that the person would desire to reject. This seems broadly what Rehnquist has in mind also, since he talks of the differential consequences of mistakes in one direction and the other, but it is less clear what provides the frame of reference for these considerations.

## 4. Discussion

Reconstruction of Supreme Court opinions using computational models is a somewhat specialist task. These opinions are not delivered as routine, but ad-

dress issues that have not yet been directly considered. For this reason, one cannot expect a situation in which there are pre-existing models to which the facts of the case can be applied to reach a decision. This explains why much of what seems to be going on in the opinions is the kind of thing that we would need to do when representing the knowledge to be used in the model, rather than applying the model. Thus we see Brennan extracting the dimensions along which a claim that a punishment is cruel and unusual from previous decisions on this point, and we see Marshall attempting to construct an argument representing the legislative will to which he can apply his critique.

But the idea of being able to supply the facts of a case and to expect opinions to be produced is too ambitious an aspiration anyway. Rather what we should be focusing on is whether, assuming an appropriate knowledge representation, we have computational argument techniques available to reproduce the arguments. From this perspective, the situation is quite promising: many of the arguments deployed by the Justices can be seen in terms of critical questions to a value based practical reasoning argument scheme, or in terms of a HYPO style approach towards reasoning with precedents represented in terms of dimensions. One way to evaluate the generality of the arguments would then be to see whether, if we represented the knowledge required to reconstruct the reasoning in one case, we could use this to reproduce the opinions in a similar case. We will briefly consider this in terms of the applicability of the arguments from *Furman* to *Gregg v Georgia*.

#### 4.1. *Gregg v Georgia*

With respect to *Furman v Georgia* a very suitable comparison case exists in *Gregg v Georgia*. Following the decision in *Furman* more than thirty five states, including Georgia, passed new legislation which removed jury discretion. Georgia, for example, issued a set of detailed statutory guidelines as to the aggravating circumstances which would authorise imposition of the death penalty, if the jury felt that the case merited it. Moreover the jury decision was subject to a mandatory appellate review. The intention was to remove the charge of arbitrariness. The Court upheld this new legislation in *Gregg* by a majority of 7-2, with Brennan and Marshall dissenting. There were two sizable concurring opinions: one by White, joined by Burger and Rehnquist, and one by Stewart, joined by Powell and Stevens (who had replaced Douglas when the latter retired). Essentially Stewart and White accept that the extensive guidelines in the new statutes mean that the death sentence is no longer being imposed arbitrarily. The view is well summarised in White's opinion:

As the types of murders for which the death penalty may be imposed become more narrowly defined and are limited to those which are particularly serious or for which the death penalty is peculiarly appropriate, as they are in Georgia by reason of the aggravating cir-

cumstance requirement, it becomes reasonable to expect that juries – even given discretion not to impose the death penalty – will impose the death penalty in a substantial portion of the cases so defined. If they do, it can no longer be said that the penalty is being imposed wantonly and freakishly, or so infrequently that it loses its usefulness as a sentencing device.

Stewart is also impressed that at least thirty five states have introduced legislation to enable the death penalty since *Furman* giving a clear indication that the state legislatures deemed the penalty to be still necessary and socially acceptable. This acceptance seems largely based on the value of retribution: White's opinion states:

capital punishment may be the appropriate sanction in extreme cases is an expression of the community's belief that certain crimes are themselves so grievous an affront to humanity that the only adequate response may be the penalty of death

So in contradiction to W1, White now finds that the sentence is not arbitrary and does serve a useful social purpose, and Stewart accepts that the guidelines mean that the sentence is no longer capriciously opposed and so S1 no longer applies.

Marshall, who remains of the opinion that retribution is not a legitimate value, dissents on these grounds: capital punishment may be thought to be required by retribution, but that does not justify it, since retribution is not a legitimate value. Similarly Brennan, who has now lost his argument BR2, now relies solely on the argument that capital punishment demotes human dignity.

From this brief summary we can see that the arguments contained in the opinions remain more or less constant, except that some decisive arguments previous available to Stewart and White (both of whom relied entirely on the arbitrary nature of the discretion) are no longer available. Moreover, as Marshall acknowledges, it is more difficult to argue that capital punishment is unacceptable in the light of the welter of post-*Furman* legislation. Therefore we might suggest that the knowledge used to reconstruct *Furman* would go a long way towards reproducing the opinions in *Gregg*.

## 4.2. Directions

The example, however, also highlights a number of directions in which we need to our extend our ability to model argumentation computationally. These are concerned with “meta” issues:

- How do we establish the appropriate standard of proof?
- How do we determine which critical questions are available in a particular forum?

- How do we determine which dimensions are relevant in a set of precedents?
- How do we resolve whether or not something is a legitimate value?
- Given two values how do we argue that one should be preferred to the other?
- How do we treat arguments such as Brennan's cumulative test, where the reasons are neither necessary nor sufficient?

Standards of proof have been discussed in [11] and the Carneades system described in that paper allows for arguments to be evaluated against a variety of different standards of proof. These are, however, taken in that work as given by the procedural context, and are not themselves the subject of debate. The opinions suggest that there might be some principles, such as *the more wide reaching the consequences, the more firmly must the premises be established*. It would be interesting to explore whether there are more such principles and how these might be deployed in a debate as to the appropriate standard of proof.

The question as to what protocol to use has been debated, since which speech acts are allowed can obviously make a difference to the outcome, but again this debate takes place between designers outside the system, rather than between agents within the system. As yet the kinds of arguments that can be used here is an unexplored topic. A mechanism to allow different parties to a debate the authority to resolve different conflicts was provided in [23], but again, while this can aid in evaluation, it needs to be seen as a given to the system.

The dimensions relevant to a set of precedents is part of the analysis required to build a system such as HYPO and CATO, and so, like the protocols, is a matter for debate amongst designers rather than within the system. However, there may be scope for argumentation here: an argumentation system which generates arguments based on mining association rules from a database of examples is described in [21]. That a feature is found in the winning arguments could be seen as a reason to regard it as a relevant dimension. Once again, however, this is an area ripe for exploration.

Resolving whether or not something is a legitimate value is also something which we have as yet no feel for how to argue about. Typically an agent chooses its own values, and a persuader must accept these values as legitimate. But, of course, in natural argument attempting to convince someone that a value should not be used, perhaps, as here, for moral reasons, is not uncommon. More examples of the types of argument that can be effective here are needed.

Arguing about value preferences has been considered in *Extended argumentation frameworks* [15], which allow attacks as well as arguments to be attacked. These extended frameworks can be used to model explicit reasoning about value preferences in a standard argumentation framework [16]. These extended argumentation frameworks provide a useful basis for exploring a number of issues relating to the acceptability of arguments based on preferences, and other 'meta' issues.

Finally, although I have assumed Brennan's cumulative test to be an example of HYPO style reasoning, it could also be related to the notion of accrual, e.g. [17]. The topic of accrual is important in a number of areas, but as yet no very satisfactory account has been produced. The relationship with HYPO style reasoning opens up additional possibilities. In fact, several of these points reveal a relationship between argumentation based on the practical argument scheme and critical questions and the case based reasoning of HYPO and CATO. Determining whether a dimension is relevant can turn on whether a value is legitimate. Case based reasoning can also be related to questions of which value is preferred: in accounts such as [8], precedents achieve their affect precisely by establishing preferences between values. Recent work [2] has explored how the legitimacy of factors and values, and preferences between values emerge in oral argument before the Supreme Court by a process of proposing and refining tests using hypothetical variants of the case at hand. Exploring the relationship between practical argument and HYPO style legal case based reasoning is something that should be pursued further.

## 5. Conclusion

Supreme Court opinions provide a challenge for argumentation. Although the knowledge required is too far-ranging to make this a feasible practical application, the opinions provide examples of reasoning methods which computational models can aspire to reproduce. Representing particular cases can thus drive argumentation research, and provide insight into the kinds of argument deployed by judges considering cases at this exalted level. In particular we find in the opinions that the Justices do not simply apply a theory to produce their arguments, but rather also construct that theory: moreover they go beyond the theory construction described in [8], where the building blocks of the theory were taken as given so that the theory involved only the relations between them, to additionally identifying the building blocks themselves. Thus relatively well understood examples of argumentation are interleaved with the kind of discussion that is currently held between designers of argumentation systems rather than modelled computationally. In this paper I have applied two techniques to model some of the arguments found in the Supreme Court opinions of a particular case. This has shown that several important features can be captured, but has also identified a number of directions for future research.

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# An Overview of the Use of Argumentation Schemes in Case Modeling

Douglas Walton

CRRAR (Assumption University)  
University of Windsor  
Windsor, Ontario  
N9B 3Y1 Canada  
dwalton@uwindsor.ca

In this paper it is shown using argumentation schemes how the problem of arguing from a rule to a case, or from one case to another, includes subsumption problems of determining whether a fact can be subsumed under the condition of a rule. Essentially this is the problem of defeasible reasoning, first articulated in modern times by the work of H. L. A. Hart (1949) on open textured legal concepts. It is shown that there is a particular group of argumentation schemes that need to be brought to bear in order to solve subsumption problems of this kind. One scheme that is obviously central is that for argument from analogy. However, it will be shown that there are other closely related schemes that are sometimes difficult to separate from argument from analogy, like argument from precedent, that also need to be taken into account. One of the problems is that the existing set of schemes in (Walton, Reed and Macagno, 2008) was designed to represent arguments commonly used in everyday conversational argumentation, not necessarily in special contexts like law. In this paper it is shown how some of these schemes need to be modified in order to be more useful for representing legal argumentation.

Section 1 presents an overview of how argumentation schemes have been applied to case modeling of legal arguments so far. This part of the paper will examine some now familiar cases, not only to see how schemes have been applied to them, but also to see how other forms of argument centrally used in each case could be represented with schemes, even though so far they have not been. The next sections of the paper focus on a certain group of schemes that are so closely connected in legal reasoning that there is a conceptual difficulty in separating them and seeing how they are connected to each other in typical chains of legal reasoning in cases. These schemes concern particular types of argumentation based on argument from analogy, argument from precedent, argument from classification and argument from a definition to a classification. The typical situation is one where there is an argument from one case to another that is based on argument from analogy and argument from classification. This type of reasoning fits the framework for case-based reasoning (CBR), where a principle from one case can be reused by applying to a new case that is similar to the first case (Ashley, 2006).

The last two sections of the paper take up the general problem that legal reasoning typically has to back up arguments that depend on classification by offering a definition of the key term used to make the classification at issue. However, since legal concepts are open textured, complete definitions, or essential definitions as they have often been called in philosophy, cannot be given in a way that would make the argument conclusive. Legal argumentation of the most common sort is typically defeasible, and the definitions that are used to support these arguments are themselves defeasible. They are continually subject to modification and are constantly in a process of evolution and refinement. A solution to this problem is offered by developing schemes that are integrated with the view that definitions can be supported or attacked by evidence, and on that basis used to support arguments from classification that are connected with other typical legal arguments like argument from analogy. It is shown how rules that can be seen as offering partial legal definitions of a contested term can be based on prior rules that are not themselves legal rules, but are based on arguments from generally accepted practices in a community.

## 1. Use of Schemes in Case Modeling So Far

The two cases that have most often been analyzed so far using schemes are *Pierson v. Post* (Atkinson, Bench-Capon and McBurney, 2005; Gordon and Walton, 2006) and *Popov v. Hayashi* (Wyner, Bench-Capon and Atkinson, 2007).

The schemes that appears to have been most prominently used so far are the one for argument from analogy (Weinreb, 2005; Wyner and Bench-Capon, 2008; Walton, Reed and Macagno, 2008, 46) and the one for practical reasoning (Atkinson, Bench-Capon and McBurney, 2005), including the value-based variant of practical reasoning (Bench-Capon, 2003; Bench-Capon, 2003a). One might expect that the most commonly employed schemes in law are those for arguing from a rule to a case, argument from classification and argument from definition to classification. Both *Pierson v. Post* and *Popov v. Hayashi* are based on the legal definition of 'possession'. However, so far, although these schemes have been applied to legal reasoning (Gordon, 2007) they do not appear to have been prominently used in any detailed analyses as applied in a substantial way to legal cases, except for argument from classification in Weinreb's case of the drug-sniffing dog as treated in (Walton, Reed and Macagno, 2008, chapter 2). This paper will explain why. Schemes for argument from witness testimony, argument from temporal persistence, and argument from memory have been applied to the Umilian case (from Wigmore) and to the Sacco and Vanzetti case (Bex et al., 2003).

In a brief presented to the court in *Popov v. Hayashi*, Gray (2002) made recommendations on first possession and surveyed how the law of capturing evolved from older cases in whaling and mining. In modeling *Popov v. Hayashi*, baseball fans' common understandings of first possession of baseballs are important to know about (Gray, 2002; Wyner, Bench-Capon and Atkinson, 2007).

In these cases, the principles that were used derived from customs, practices and understandings of persons in the special fields of activity (whaling, baseball). In *Pierson v. Post* (3 Cai. R. 175; 1805 N.Y. LEXIS 311), the judges cited older traditions as learned authorities.

Puffendorf (lib. 4, ch. 6, sec. 2 and 10) defines [HN3] occupancy of beasts *ferae naturae*, to be the actual corporeal possession of them, and Bynkershock is cited as coinciding in this definition. It is indeed with hesitation that Puffendorf affirms that a wild beast mortally wounded or greatly [\*\*6] maimed, cannot be fairly intercepted by another, whilst the pursuit of [\*178] the person inflicting the wound continues. The foregoing authorities are decisive to show that mere pursuit gave Post no legal right to the fox, but that he became the property of Pierson, who intercepted and killed him.

These arguments do not fit the scheme for argument from expert opinion, or the one from argument from precedent, as one might expect. Two of the sources are cited as agreeing on a definition. As will be shown in section 4 below, arguing from definition to classification needs to be taken more seriously as a form of reasoning in AI and law. Although the principles cited are not precedents, they seem to be based on generally accepted rules of common practice that may not be legally binding but are important to consider. It will be shown in section 5 that these arguments could be based on schemes for argument from generally accepted practices.

Legal examples were sometimes used in the argumentation literature on schemes, but most of the examples were derived from everyday conversational (non-legal) argumentation. Legal argumentation can be more complex in some instances because there are procedural rules and rules of evidence that affect the form in which an argument needs to be put if it is to be considered admissible. Hence when we try to apply these schemes to real legal cases in any depth and detail, many questions of fit arise.

## 2. Arguments from Analogy and Classification

Part of the problem, as shown in (Walton, Reed and Macagno, 2008, chapter 2), is that there is not complete agreement within the field of argumentation on how the scheme for argument from analogy should be represented. Version 1 of Argument from Analogy is represented as follows in (Walton, Reed and Macagno, 2008, 315).

Similarity Premise: Generally, case *C1* is similar to case *C2*.

Base Premise: *A* is true (false) in case *C1*.

Conclusion: *A* is true (false) in case *C2*.

The fundamental problem with this simple version of the scheme for argument from analogy is how the notion of similarity in the first premise should be defined. In everyday reasoning, similarity works by a process of pattern

recognition where one case is similar enough to a second case so that there is a “lock”, so that the user can immediately perceive the similarity. The next problem is how similarity can be measured or approximated. In his outline of the basic principles of case-based reasoning is applied to law, Ashley (2006) has provided a survey of ways of judging similarity, using devices like factors and dimensions, in systems like CATO and HYPO.

The next problem is that this simple version of the scheme for argument from analogy does not work very well in some cases (Weinreb, 2005, 32). For example, consider the argument: this apple is red and tastes good; this ball is red; therefore it will taste good. Here the argument from analogy fails because the observed similarity between the source and the target is not “relevant to the further similarity that is in question.” (p. 32). But what does relevance mean, or how could it be measured? According to Ashley, 2006, 41), “CATO’s (and HYPO’s) basic measure of relevance is on-pointedness; a case is on point if it shares at least one factor with the problem”. The problem is that the simple scheme above makes no mention of relevance or factors. So how can it be applied?

To contend with this problem, there is also a more complex version of argument from analogy, called version 2 in (Walton, Reed and Macagno, 2008, 58).

Similarity Premise: Generally, case *C1* is similar to case *C2*.

Base Premise: *A* is true (false) in case *C1*.

Relevant Similarity Premise: The similarity between *C1* and *C2* observed so far is relevant to the further similarity that is in question.

Conclusion: *A* is true (false) in case *C2*.

In an example from the widely used logic textbook (Copi and Cohen, 1983, 101), cited in (Walton, Reed and Macagno, 2008, 58-59), two cases, prospecting for gold and scientific research, are presented as similar in relevant respects.

As in prospecting for gold, a scientist may dig with skill, courage, energy and intelligence just a few feet away from a rich vein – but always unsuccessfully. Consequently in scientific research the rewards for industry, perseverance, imagination and intelligence are highly uncertain.

The reason Copi and Cohen give (1983, 101) for the relevance of the similarity is that both fall under the category of “quest”, constituted by difficulty, training and fortune. But notice that this argument is partly based on a classification, arguing that two cases are relevantly similar because they fall under the classification of quest. This shows that argument from classification can sometimes be used to support argument from analogy. More commonly it is the other way around, as in the drug-sniffing dog case (below), where argument from analogy is used to support argument from classification.

The scheme for argument from verbal classification is also very important in AI and law. Obviously, for example, if something can be classified as a contract or a wetland, the consequences can be very significant in legal reasoning. Argument from classification can sometimes have a deductive form (Walton, Reed and Macagno, 2008, 66), but in the most common instances in law such argu-

ments fit the following defeasible scheme (Walton, Reed and Macagno, 2008, 319).

Individual Premise: individual *a* has property *F*.

Classification Premise: For all *x*, if *x* has property *F*, then *x* can be classified as having property *G*.

Conclusion: *a* has property *G*.

There can be various ways to support argument from classification, but one of the most common is to present a definition of some key term. There are a lot of problems with definition in philosophy, since the traditional notion of the Aristotelian essential definition has long been abandoned, and there appears to be nothing presently available to fill this gap. It is a problem both in philosophy and law that the notion of definition does not appear to be taken as seriously as it should be.

The example of the drug-sniffing dog (Brewer, 1996) shows how an argument that has been classified in the law literature as argument from analogy is really an instance of arguing from analogy to a verbal classification. If a trained dog sniffs luggage left in a public place and signals to the police that it contains drugs, should this event be classified as a search according to the Fourth Amendment? If it can be classified as a search, information obtained as a result of the dog sniffing the luggage is not admissible as evidence. If it is not classified as a search, the information is admissible.

On Brewer's analysis, this first classificatory stage of reasoning by analogy leads to a later evaluation stage in which the given event is compared to other cases that have already been classified legally as being searches or as not being searches. On his analysis, we would seem to have a chain of reasoning going from argument from analogy to a verbal classification and from there to further arguments from analogy. However we analyze such cases, it seems apparent that argument from analogy and argument from classification are closely connected in common instances of legal argumentation.

Finally in this section another scheme needs to be added, because very often in legal argumentation the best way to critically question an argument from verbal classification is to ask for a definition of the term on which the classification was based. This leads us to a consideration of the scheme for argument from definition to verbal classification (Walton, Reed and Macagno, 2008, 319).

Definition Premise: *a* fits definition *D*.

Classification Premise: For all *x*, if *a* fits definition *D*, then *x* can be classified as having property *G*.

Conclusion: *a* has property *G*.

The following critical questions match this scheme.

CQ<sub>1</sub>: What evidence is there that *D* is an adequate definition, in light of other possible alternative definitions that might exclude *a*'s having *G*?

CQ<sub>2</sub>: Is the verbal classification in the classification premise based merely on a stipulative or biased definition that is subject to doubt?

For example, in the case of the drug-sniffing dog, a definition of the term 'search' might be offered, based on a statute or a court decision, and then the definition might be used to back up the argument from classification. We will look at some examples of how to define and classify a search in section 4.

### 3. Arguments from Precedent and Established Rule

Argument from analogy is fundamentally important in AI and law, and probably nobody would deny that. But is case-based reasoning better viewed as modeling other schemes such as argument from verbal classification or argument from precedent? To examine this issue, we look at the scheme for argument from precedent (Walton, Reed and Macagno, 2008, 344). This scheme would apply in a case, for example, there is a rule that vehicles are not allowed in the park, but where in this instance, the vehicle is an ambulance. In this case, the exception to the rule must be recognized. This might lead to modification of the rule as follows: vehicles are not allowed in the park, except for ambulances.

Major Premise: Generally, according to the established rule, if *x* has property *F*, then *x* also has property *G*.

Minor Premise: In this legitimate case, *a* has *F* but does not have *G*.

Conclusion: Therefore an exception to the rule must be recognized, and the rule appropriately modified or qualified.

This scheme, however, does not apply to cases of argument from precedent of the kind used most characteristically in legal reasoning. This scheme applies to a kind of case in which there is an established rule, but an exception to it is found of the kind that requires modifying the rule by allowing the case at issue as representing a legitimate exception. So this kind of argument could be called argument from the creation of a precedent.

The more common type of argument from precedent used in legal reasoning applies to a different type of case. In this kind of case, there is a case at issue, and a prior case that has already been decided is taken as a precedent that can be applied to the present case. The argumentation scheme appropriate for this latter type of legal argumentation can be set up as follows.

Previous Case Premise: *CI* is a previously decided case.

Previous Ruling Premise: In case *CI*, rule *R* was applied and produced finding *F*.

New Case Premise:  $C2$  is a new case that has not yet been decided.  
 Similarity Premise:  $C2$  is similar to  $C1$  in relevant respects.  
 Conclusion: Rule  $R$  should be applied to  $C2$  and produce finding  $F$ .

It is the scheme above that should properly have the name of argument from precedent in legal reasoning. The prior scheme above, called argument from precedent in (Walton Reed and Macagno, 2008, 344) needs to be re-labeled, and should now be seen as representing arguments from an exception to the creation of a precedent. Note that this new scheme classifies argument from precedent as a species of argument from analogy.

The scheme called argument from an established rule, as represented in (Walton, Reed and Macagno, 343), is shown below.

Major Premise: If carrying out types of actions including the state of affairs  $A$  is the established rule for  $x$ , then (unless the case is an exception),  $x$  must carry out  $A$ .  
 Minor Premise: Carrying out types of actions including state of affairs  $A$  is the established rule for  $a$ .  
 Conclusion: Therefore  $a$  must carry out  $A$ .

But once again, this scheme does not apply to the common kind of case in law where an established rule is applied to a particular case, say by a judge. In this kind of case, the argumentation scheme for argument from an established rule has the following form.

Major Premise: If rule  $R$  applies to facts  $F$  in case  $C$ , conclusion  $A$  follows.  
 Minor Premise: Rule  $R$  applies to facts  $F$  in case  $C$ .  
 Conclusion: In case  $C$ , conclusion  $A$  follows.

This defeasible form of argument is extremely common in legal argumentation, as well as in AI. Indeed, it could simply be called rule-based reasoning.

We now have a group of schemes, comprising argument from analogy, argument from classification, argument from definition to classification, argument from precedent, and argument from an established rule. Now let's briefly discuss some problems with attempting to apply these schemes to typical instances of legal case-based reasoning

#### 4. Applying these Schemes to Cases

Wyner and Bench-Capon (2007) presented a reconstruction of legal case-based reasoning using a series of hypothetical cases extended from the *Mason v. Jack Daniels* case in which a bar owner's secret recipe for Lynchburg Lemonade was

used in a promotion by a whiskey manufacturer. Their method was to compare the current case by analogy to a previously decided case on the basis of factors. The tool they devised is a set of six argument structures they describe as argumentation schemes. For example (143) their main scheme (AS1), looks like this, where P is the plaintiff, D the defendant, P<sub>i</sub> are the factors, CC is the current case and PC is the precedent case.

P Factors Premise: P<sub>1</sub> are reasons for P.

D Factors Premise: P<sub>2</sub> are reasons for D.

Factors Preference Premise: P<sub>1</sub> was preferred to P<sub>2</sub> in PC<sub>i</sub>.

CC Weaker Exception: The priority in PC<sub>i</sub> does not decide CC.

Conclusion: Decide CC for P.

These six argument structures do not look like ordinary argumentation schemes, according to the way the notion of an argumentation scheme is currently used in argumentation theory. They contain the notions of proponent and respondent and provide a tool for determining whose side has the stronger argument on the balance of considerations at any given point as a case is argued. They are better seen as schemes within a system like Carneades (Gordon, Prakken and Walton, 2007) for determining which side has the stronger argument at a point during the argumentation stage, as factors are introduced on one side and the other, during the putting forward of and responding to an argument from precedent. However, these factor-based schemes come under the category of argument from precedent, where a current case is compared to a previous one on the basis of factors. They are special schemes that work as methods for evaluating a given argument from precedent in a dialog sequence in a case in a system.

When I first started to try to apply argumentation to legal reasoning, it appeared that many of the rules applied to facts to generate a legal conclusion in a case were based on definitions of key legal terms, like ‘contract’ and so forth. Hart’s famous example of deciding whether a skateboard is a vehicle that ought to be banned from the park is a case in point (Hart, 1949; 1961; Loui, 1995). It looks like all we have to do is to define the concept of vehicle, and from the definition we can make a reasoned decision about whether a skateboard should be classified as a vehicle or not. This classification would then give us the rational support required for ruling on a case where someone’s riding a skateboard in the park needs to be judged as illegal or not. But after examining many cases, it began to occur to me that it is not possible to give a legal definition, certainly in hard cases, that provides sufficient support by itself to arrive at a decision. The reason, of course, is that legal concepts like vehicle are open-textured, to use Hart’s term, or defeasible, to use the current term.

This problem is as common in philosophy as it is in law, where it often seems impossible to offer a definition that is not so contestable that in the end it appears to be unconvincing as a useful tool to resolve disputes and move ahead. But as I examined some more cases, I began to see that the law does

have a method for resolving the problem. What it does is to articulate rules or principles that are sometimes established by the courts based on previous cases, and in other instances may even be based on commonly accepted practices that have found their way into law as supporting the formulation of such rules. A set of such rules can provide necessary or sufficient conditions that function as partial definitions help the argumentation to move forward even in the absence of a fixed definition that is complete and that can be mechanically applied to any case falling under the heading of the so-called elements of the case. Two examples of this phenomenon will serve to illustrate how it works.

Weinreb (2005, p. 24) cited three general rules established by prior court decisions that can be applied to Brewer's case of the drug-sniffing dog.

Rule 1: If a police officer sees something in plain view in a public place, the information collected is not classified as a search.

Rule 2: If a police officer opens luggage and then observes something inside the luggage, the information collected is classified as a search.

Rule 3: If a police officer listens surreptitiously to a conversation in a private place, it is classified as a search..

These three rules are fairly specific and can be applied to a case at issue by seeing whether the case fits the condition stated in the antecedent of the conditional. If it does, a conclusion can then be drawn about whether the case should be classified as a search or not. Hence these rules can be used to support or attack argument from classification.

There is also a more general rule that Brewer called an analogy warranting rule (AWR) formulated by Weinreb (2005, p. 24) as follows.

AWR: If a police officer obtains information about a person or thing in a public place without intrusion on the person or taking possession of or interfering with the use of the thing, it is not a search for purposes of the Fourth Amendment.

This rule seems to be similar to the above three, in that it also functions as a partial definition of the concept of a search that can be applied to a particular case and yield a ruling on whether the case should be classified as a search are not. But it is different from the other three rules and at least two ways. First, it seems more general, because it defines the concept of a search in terms of other even more general legal concepts, like intrusion on a person and taking possession of thing. Second, is based on an interpretation of an authoritative statute, namely the U.S. constitution. This case shows that even though it may not be possible to give a set of necessary and sufficient conditions that completely defines the concept of the search, nevertheless several rules that classify certain things as being a search or not can apply to a new case and act as a partial definition.

## 5. Laws and Generally Accepted Practices

The other case illustrating this point is even more interesting in showing where these rules come from. The basic problem in the case of *Popov v. Hayashi* was that the law does not have the complete enough definition of the notion of possession that could be applied to solve the problem of whether Popov can properly be said to have possessed the ball when the party, after it left Barry Bonds' bat and was partly caught by Popov then lost when he was mobbed by a group of fans. The existing laws on possession that were applied to this case came from cases concerning the capture and possession of wild animals. Applying one kind of case to another where the circumstances are very different seems to involve a kind of reasoning by analogy. Gray (2002) showed how an excellent example of this kind of judicial decision making can be found in rulings on whaling. It was found in Anglo-American cases where the ownership of the whale carcass was contested that judges deferred to commonly accepted principles used by the whalers themselves. These principles or rules in effect offered partial definitions of what it is to possess a wild animal. Different kinds of rules depended on different kinds of whales and the circumstances under which they were caught, like the depth of water and how fast a type of whale can swim. In *Pierson v. Post* (3 Cai. 175, 2 Am. Dec. 264 (N.Y. Spp. Ct. 1805)), similarly, laws of possession and capture were formulated by basing them on commonly held customs and practices previously accepted by those engaged in hunting and fishing in comparable activities in the past. Gray (2002, 4) showed that the California supreme court deferred to accepted customs and practices of those engaged in prospecting when they had to decide disputes between competing gold miners on who was entitled to water from a stream flowing through both of their claims.

From cases like this we can see that law is not in a position to offer complete definitions of fundamental concepts like search and possession that offer necessary and sufficient conditions that can be applied to any new case to solve the problem and make a ruling. So-called essential definitions are not available, but this absence should not be too surprising given from what we already know from Hart about the open-textured nature of legal concepts.

## 6. Arguments from Generally Accepted Practices

What is interesting here is the notion that legal rules partly define a concept that may be partly derived from, and may be held to be desirably consistent with previously existing customs practices and understanding of those engaged in common activities like hunting, fishing and gold mining. To illustrate this point, Gray (2002, 6) formulated six important concepts or rules about the understanding of first possession of baseballs accepted by fans and other participants in the sport of baseball. Two of these rules can be used to illustrate how each rule acts as a partial of definition of the notion of a catch. One is the

negative rule that a catch does not occur simply because the ball hits the fan on the hands or enters the pocket or webbing of the fan's baseball glove. Another is the positive rule stating that a catch does occur when the fan has the ball in his hand or glove, the ball remains there after its momentum has ceased, and even remains there after the fan makes incidental contact with a railing, wall, the ground or other fans who are attempting to catch the baseball or get out of the way.

These commonly accepted rules show how legal rulings based on applying open-textured legal concepts to new cases can partially depend on evidence drawn from commonly accepted practices that exist prior to the legal framework. The use of such arguments prior to the legal framework can be represented by the scheme for argument from popular practice (Walton, Reed and Macagno, 2008, 314).

Major Premise: *A* is a popular practice among those who are familiar with what is acceptable or not in regard to *A*.  
 Minor Premise: If *A* is a popular practice among those familiar with what is acceptable or not with regard to *A*, that gives a reason to think that *A* is acceptable.  
 Conclusion: Therefore, *A* is acceptable in this case.

### Critical Questions

CQ<sub>1</sub>: What actions or other indications show that a large majority accepts *A*?  
 CQ<sub>2</sub>: Even if large majority accepts *A* as true, what grounds might here be there for thinking they are justified in accepting *A*?

It is clear from the statement of the minor premise that such arguments are defensible. They can be argued against, and it can be argued that they are not applicable.

## 7. Conclusions

This paper has examined a special group of schemes that are typically tightly woven in together when arguing from one case to another as in CBR. Once they are clearly distinguished, we can get a better perspective on how the CBR process in law retrieves a past case that is similar to the target case, in order to solve the target problem. The problem is very often how to classify something. In an easy case, the classification problem can be solved by simply fitting it in under a previously accepted rule, whether it is a legal rule or a generally accepted practice, or a definition that has already been accepted as authoritative.

In a hard case, this may not solve the problem because, for one thing, concepts are open-textured, and for another thing, because of this, it is generally not possible to formulate a set of necessary and sufficient conditions that are complete to solve the problem.

How the six argument factor evaluation structures for argument from precedent (Wyner and Bench-Capon, 143-146, 2007) fit into the framework I have outlined here is not still entirely clear to me, possibly because I've never encountered anything like this device before in previous argumentation theory. It's something new. However, it strikes me that the device is extremely useful, because it provides a way of evaluating an argument from precedent while it is being put forward during the argumentation stage, and where it is being attacked by arguments from opposing precedents.

How does the process of applying these schemes to cases work, in general? The main points in the procedure can be set out as follows.

- The process uses general rules derived from legally authoritative sources by statutory interpretation.
- It uses arguments from analogy to previous decided cases.
- The new version of argument from precedent is based on argument from analogy.
- When so based, it can be evaluated by the six factor evaluation structures.
- It may also be based on argument from an established rule.
- In some instances, legal reasoning uses argument from generally accepted practices in specific kinds of practical activity domains.
- Significantly, it uses and arrives at classifications based on these rules.
- Instead of fixed definitions, it uses defeasible partial definitions in the form of necessary and sufficient condition rules.
- It applies these rules to the problematic case that needs to be decided by examining and weighing the arguments pro and contra based on the evidence from these and other sources.

The best we typically have are some general rules that are defeasible and that may be more or less on point. However, we have tried to show in this paper that such a set of rules can provide what can be called a defeasible definition, a definition that is not complete for making a classification beyond further arguments, but can move the argumentation in a case forward by supporting other arguments.

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# A Case study of Medico-Legal Argumentation in Disability Assessment (research abstract)

Henry Prakken

Department of Information and Computing Sciences,  
Utrecht University and Faculty of Law,  
University of Groningen,  
The Netherlands

This research abstract reports on a case study of the argumentative structure of medico-legal decisions on disability assessment. Such decisions are made by social-insurance physicians whose task is to evaluate social-benefit claims on grounds of incapacity of work. The original aim of the case study was to investigate how such decision making can be made better and more transparent. This involved two aspects: developing a rational model of argumentative disability assessment, and investigating automated support of such a model with tools from AI & Law. The underlying motivation for an argumentation approach arises from the claim that improved quality of disability assessment can only be operationalised as increased consensus among the decision makers: argumentative assessment may contribute to such increased consensus by forcing the decision makers to make the grounds for their assessments explicit, so that these become open for criticism by and debate with other decision makers.

The case study ignored the procedural aspects of disability assessment (e.g. data gathering, interviewing the claimant) and focused only on the structure of the arguments given by the decision makers. It involved a study of the argumentative structure of four examples of ‘mediprudence’ (a literal translation of the Dutch word ‘mediprudentie’, which plays with the Dutch word ‘jurisprudentie’, meaning ‘case law’). These examples are the result of an experiment in which a group of social-insurance physicians jointly formulated example decisions in argumentative style (De Boer & Steenbeek 2005). The idea is that these example decisions are made available to social-insurance physicians as normative examples of argumentative disability assessment and as case-specific sources of medico-legal knowledge (analogous to the role of case law in legal decision making).

The identified argumentation structures have been visualised with the Araucaria software (Reed & Rowe 2004). All visualisations are, with the texts of the four decisions, available at <http://people.cs.uu.nl/henry/smba08.html> (although all material is in Dutch). The case study is reported in more detail in Prakken & Dijkstra (2009), also in Dutch.

First it was investigated to what extent the structure of the decisions agrees with the basic structure of arguments as defined in argumentation theory (and as supported by Araucaria). It was found that all four decisions largely confor-

med to this basic structure. Most arguments were both ‘horizontally’ and ‘vertically’ complex. *Vertical complexity* means that the conclusion of one argument can be a ground of another argument, while *horizontal complexity* means that a conclusion is supported with multiple grounds. With respect to the latter, both *linked* (all grounds needed to support the conclusion) and *convergent* (one ground sufficient to support the conclusion) combinations were found. In addition, a third type of horizontal complexity was identified, which could be called *aggregation*. This is the case when it holds that the more grounds support the conclusion, the better the conclusion is supported. In AI & Law this is by now commonly known as reason- or factor-based reasoning. Clearly, multiple grounds can be aggregate only if each ground is no more than a defeasible reason to support its conclusion, otherwise the combination would be one of convergence. Whether a combination of grounds is of the linked, convergent or aggregate type is a matter of interpretation (which is often hard). In Araucaria the difference between convergent and aggregate grounds cannot be shown; therefore in this case study aggregate grounds have been visualised as convergent.

Next it was found that counterarguments were rather frequent, where all three types of attack (on a premise, on a conclusion, and on the inference) occurred (although in some cases whether an attack is on an inference (i.e., an undercutter) depends on whether argument schemes are regarded as implicit premises or as inference rules). Note also that if a premise of a vertically complex argument is attacked, this often is at the same time an attack on the conclusion of another argument. Only in one case was a priority argument found that decided a conflict between arguments.

Zooming in on the basic structures it was found that rule-like premises were often left implicit.<sup>1</sup> Some implicit premises were empirical generalizations. Other ones were classification rules (classifying certain sets of symptoms as ability or disability to do a certain type of work); some of these mixed medical and socio-normative concerns. Yet other implicit premises can be regarded as applications of argument schemes (therefore their classification as implicit premises depends on whether argument schemes are regarded as premises or as inference rules). For example, both citations of medical examinations of the claimant and citations of the medical research literature can be regarded as arguments from expert testimony, while uses of statements of the claimant can be regarded as witness testimony arguments. In a few cases a scheme for abductive explanation of symptoms was used, and in some other cases the argument scheme from negative consequences was used (‘this type of work can lead to this medical problem by this patient, so this kind of work cannot be regarded as suitable for him’). Finally, a few counterarguments could be

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1. A classification of types of grounds can be found in De Boer et al. (2008), who report on an experiment in which social-insurance physicians from several European countries were encouraged to formulate explicit grounds for their decisions in example cases.

regarded as applications of critical questions of such argument schemes, but this was not very frequent.

A final finding was that parts of decisions were reused in other decisions, in cases where the same sub-issue had to be decided (sometimes including the same counterarguments).

With respect to the potential for automated support with AI & Law tools several issues are discussed in Prakken & Dijkstra (2009), two of which will be briefly mentioned here.

Firstly, the main interpretation problem in this case study was whether a combination of grounds was convergent or aggregate. In fact, it seems that in most cases the support was aggregate. Combined with the finding that parts of decisions were occasionally reused, this suggests the possible use of structures like CATO's factor hierarchy (Aleven 2003). In any case, a support tool should arguably support a clear distinction between convergent and aggregate grounds for conclusions.

The second issue concerns the fact that several social-insurance physicians involved in the studies of De Boer et al. (2008) and De Boer & Steenbeek (2005) stated that when they decide a case they usually keep a 'general picture' of the claimant in mind, as acquired from the case files and their personal contacts with the claimant. This was not reflected in the text of the decisions, which are in 'atomistic' argumentative style. Related issues have arisen in research on legal-evidentiary reasoning, where some have proposed an argumentative approach while others maintain that a more 'holistic', story-based approach is better. In a recent project on crime investigation a combined story-based and argumentative model and software tool were proposed in an attempt to combine these 'atomistic' and 'holistic' approaches to legal evidentiary reasoning (Bex et al. 2007, van den Braak et al. 2007). It would be interesting to investigate whether a similar combined model and support tool can be developed for the present domain.

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# Toward Modeling Analogical, Teleological and Hypothetical Legal Reasoning in a Case Microworld

Kevin D. Ashley

University of Pittsburgh School of Law  
Learning Research and Development Center  
Ashley@pitt.edu

## Research abstract

This abstract summarizes an approach to modeling legal cases that involves drawing abstract analogies across cases, reasoning teleologically about rules for deciding a case, and posing hypothetical cases to test proposed decision rules. The full paper [1] presents a more complete description; an extended example of the targeted behavior illustrates the requirements for an ontology that provides representational support for a computational model of the behavior in a yet-to-be-developed legal reasoning system. The example centers on a microworld of legal discourse, an ensemble of real legal cases, hypothetical examples, concepts, factors, principles and policies. Beginning with any case in the microworld, the system's goal would be to generate arguments that a law professor and students might reasonably make in discussing the legal case in class. More specifically, given the case facts, the system should output an extended discussion, including the students' arguments explaining how the case should be decided and the professor's responses probing those arguments. The arguments would include:

- Proposing tests or rules for deciding the case. Advocates or judges propose a rule as a kind of hypothesis about how the case should be decided and defend it as consistent with past cases and underlying principles and policies.
- Citing past cases (i.e., precedents) in support of a proposed decision and drawing analogies at various levels of abstraction to and among the current problem and precedents.
- Justifying the proposed tests and the analogies in terms of principles and policies of the legal domain.
- Challenging the proposed tests by posing "hypotheticals", that is, imagined situations that involve the proposed test (i.e., the hypothesis) and explore its meaning or challenge it as too broad or too narrow [2].
- Responding to the hypotheticals, for instance, by modifying the proposed test or by analogizing or distinguishing the problem and hypothetical [2].

These are common features of law school classroom Socratic discussions. The problem case and precedents are often those reported in the course text or “casebook”. Having read the cases, students are encouraged to induce general rules that summarize the legal issues and guide legal decision-making but also to understand the rules’ scope and limitations. The classroom discussion of particular case facts focuses students on the need, given the particular circumstances and the underlying regulatory principles and policies, to consider more context-sensitive interpretations of the rules and the possibility of exceptions.

In order to model dialogical behavior involving analogical, teleological, and hypothetical reasoning, a suitable ontology would help. The ontology would represent the knowledge of the domain so that an automated reasoner could represent problems and generate solutions [6, pp. 244f; 9]. It would provide the conceptual terminology and contribute to the structure of the knowledge base that enables the system to understand assertions about the problem situation and past cases. This is important because the inference engine will not only reason with rules but use case comparisons to reason about rules. It will compare a problem with relevant past cases, characterize the relevant similarities and differences at various levels of abstraction, propose rules for deciding the case, and justify them in terms of the past decisions and underlying principles and policies. The ontology provides the terminology for characterizing similarities and differences across cases at an appropriate level of abstraction. The full paper explores some requirements such an ontology must satisfy and some challenges in achieving three important roles:

1. *Supporting case-based comparisons*: representing cases, the justifications of case decisions, and case-based arguments in order for the reasoning system to find relevant cases, compare them with the problem, characterize the relevant similarities and differences at various levels of abstraction, and draw inferences based on the comparisons about how to decide the problem.
2. *Supporting distinguishing deep and shallow analogies*: Representing cases and case explanations so that the reasoning system can identify relevant cases despite superficial dissimilarities or irrelevant ones despite superficial similarities.
3. *Supporting inducing/testing hypotheses*: Representing cases and rules so that the reasoning system can induce defensible hypotheses at various levels of abstraction about how to decide a problem from a database of suitably represented cases, and evaluate and modify the hypotheses (e.g., using hypothetical reasoning.)

The extended example involves a microworld of cases centered on *Pierson v. Post*, 3 Caines R. (N.Y.1805), a case often treated in first year property law courses and familiar to researchers in AI and Law [5, 4, 3, 8]. It applies common law (i.e., judge-made as opposed to statutory law) to the question of under

what circumstances hunters have property rights in the animals they pursue. Beside *Pierson*, the microworld includes *Keeble v. Hickeringill*, *Young v. Hitchens*, *Popov v. Hayashi*, the Escaping Boar case, and two hypothetical cases: Flushing Quail and Competing Schoolmasters. The extended example in the full paper focuses on a discussion of the *Young* case. A defendant commercial fisherman caught fish from within the still open nets plaintiff commercial fisherman was closing around the fish; the defendant defeated the plaintiff's claim of interference with property with respect to the issue of plaintiff's possession where the plaintiff had not yet captured the fish. Although the ensuing 6-part discussion is too lengthy to reproduce here, its flavor can be discerned from the following short example discussion of the *Popov* case in which the *Young* case is discussed. An advocate may propose a rule or test for deciding a dispute, for example,

"If a baseball fan does not have possession of a home run ball hit into the stands, then he has no property interest to enforce against another fan, who picked up the ball after a scuffle."

The test synthesizes and applies a lesson the advocate draws from an analogous prior case, *Pierson*. There a hunter had no property claim to a fox he had not killed or mortally wounded before another hunter intercepted it. Is it a good test? How does one know? A skeptic might object:

"Suppose while a commercial fisherman closed his nets on a school of fish, another swooped in with a fast boat and scooped them up with a smaller net. Shouldn't the commercial fisherman recover for the sake of his livelihood?"

"The plaintiff commercial fisherman in the *Young* case didn't recover", the problem solver may rejoin, "but, in any event, the baseball fan does not make his livelihood from grabbing home run balls."

"But Barry Bonds' last home run ball is worth fifty such livelihoods," the skeptic replies.

This short example illustrates some features of interpretive legal arguments that have yet to be computationally modeled in a robust way. In the example, arguers draw abstract cross-case analogies, propose rules for deciding cases at various levels of abstraction, and evaluate those rules from a teleological viewpoint.

Manipulating abstract descriptions of case facts is a key technique, not only for analogizing and distinguishing cases but for reconciling the decision of a particular case with precedents in a rule for deciding a case. As pointed out in [3] when the *Popov* case was decided in 2002, the judge regarded the *Pierson* and *Young* cases as analogous because they involved a similar issue of plaintiff's possession and similar circumstances: defendant took the "quarry" (a baseball) as plaintiff was closing in. The analogy is implicit in the rule that the advocate proposes. In order to propose rules for deciding a case in harmony with precedents, a legal reasoning system needs to "understand" analogies expressed more abstractly than the fact descriptions in particular cases or even in factors. Thus, in this microworld, a system needs to relate intercepting a fox plaintiff chased with pocketing a baseball plaintiff partially caught. It needs

to relate catching fish in open water with chasing foxes on open land and catching home run balls in the stands of a private ball park into which one has been invited.

The decision rules will be derived from cases and applied deductively, but there will also be arguments about what the rules mean and how they should apply. The advocates and decision-makers interpret, challenge, and change the rules in a process of case comparison. An advocate proposes a test that explains a past result, and leads to the desired result in the current facts, as a matter of deductive reasoning. The proposed test is subject, however, to a process of interpretation in which, among other things, skeptics pose hypothetical examples to explore the meaning of its terms and to assess its fit with past decisions and principles. As part of that process, the test is applied deductively to the facts of hypotheticals and precedents, but that is only part of the process. The results must be assessed in light of underlying domain principles and policies. Rather than an authoritative source of a rule, a past case is thus seen as a more-or-less authoritative result: a given set of facts from which subsequent advocates and judges may extract a range of rules in light of the problem situation's facts, other prior decisions, and underlying principles/policies. Ideally, the induced rules will embody a realistic legal theory of how to decide a case that summarizes precedents and values [7] but that also reflects the meanings of legal predicates and principles.

Having proposed a rule for deciding the problem, judges, teachers, and well-informed advocates and students critically evaluate how well the rule and its results square with underlying principles and policies often by posing hypothetical fact situations designed to expose a rule's over- or under breadth. For instance, in the above example, the commercial fishing hypothetical suggests that the plaintiff's rule is too broad; applying such a rule could deprive a fisherman of his livelihood. That was a cost the court in the *Young* case, on which the hypothetical was based, was prepared to accept, but the hypothetical suggests the possibility that case was wrongly decided. Critiquing prior decisions is another tool that should be modeled for reconciling a proposed decision with past cases in light of underlying principles.

Beside cases that are relevant despite superficial dissimilarities, the microworld also has some that are irrelevant despite superficial similarities. To help the system distinguish among them, the ontology needs to represent classes of, and support reasoning about, legal claims and issues. For instance, the Escaping Boar case involves an issue of possession of a wild animal on one's land that is also a nuisance pest. It may appear to relate, but on closer inspection, the scenario, claim, and issue are different. The case involves a claim of strict liability (i.e., liability without fault) or in negligence where an animal kept by the defendant on his own property escaped and damaged the neighbor's property. The issue is whether the defendant owner of the escaping animal is liable for the economic injury sustained by his plaintiff neighbors. In order to distinguish such superficially similar cases, the case base needs to represent the claims, issues and facts in a more structured way so that the re-

lations among plaintiff, defendant, defendant's injuries and the way they were caused can be taken into account.

In conclusion, the proposal is to use microworlds of legal discourse to incrementally design a model of legal cases to accommodate teleological, analogical, and hypothetical reasoning. The examples can gradually be made more complex so that more advanced behavior can be simulated, tested, and accommodated. One may modify and expand the microworld to introduce new challenges, and then tackle a small number of more or less tangentially related microworlds. Since each microworld has a sufficiently large number of cases represented at multiple levels of generality, the system is likely to discover arguments that human reasoners miss. Further challenges can be introduced incrementally, for instance, starting with proposed tests as givens versus generating tests on the fly, or starting with test concepts as given versus "inventing" concepts via composition.

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