

A Carneades Reconstruction of Popov v Hayashi

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Abstract

Carneades is an open source argument mapping application and a programming library for building argumentation support tools. In this paper, Carneades' support for argument reconstruction, evaluation and visualization is illustrated by modeling most of the factual and legal arguments in Popov v Hayashi.¹

1 Introduction

Carneades is an open source argument mapping application and a programming library for building argumentation support tools.² Carneades is based on a formal, computational model [Gordon et al., 2007] of Walton's theory of argument structure and evaluation [Walton, 2006] and is designed to support a variety of argumentation tasks, illustrated in Figure 1.

In this paper we want to focus on just two of these tasks, by using Carneades to reconstruct and critically evaluate Judge McCarthy's arguments in his decision of the Popov v Hayashi case, similar to the way we have used Carneades previously to model Pierson v Post [Gordon and Walton, 2006].

Our methodology for reconstructing and evaluating arguments using Carneades, which we also used in our reconstruction of Pierson v Post, can be summarized as follows:

1. Make a list of all of the atomic propositions in the arguments. We use the term "statement" as a synonym for "atomic proposition".
2. Assign each statement in the list an identifier, or *key*, to make it easy to refer to them later, creating a *key list*.

¹The final publication is available at www.springerlink.com

²<http://carneades.github.com>

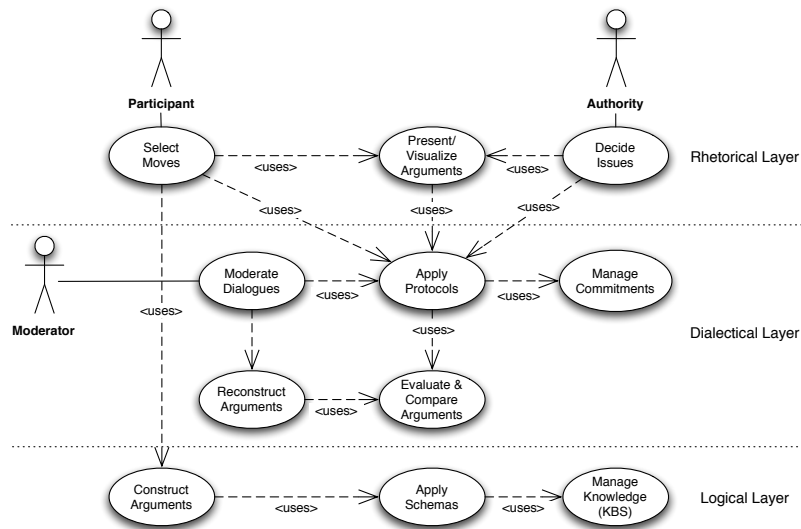


Figure 1: Argumentation Uses Cases

3. Identify the premises and conclusion of each argument, where each premise and conclusion is a statement in the key list.
4. A premise of one argument may be the conclusion of another. Use the Carneades mapping tool to create an argument diagram, by linking the shared statements of the arguments.
5. Assign a proof standard, such as “beyond a reasonable doubt”, to each statement in the graph.
6. Label each argument with the argumentation scheme used to construct the argument.
7. From the perspective of the *audience* of interest, in this example Judge McCarthy, label the statements which have been accepted as true, or rejected as false, by the audience, without argument. These accepted and rejected statements are assumptions of the audience.
8. Starting with the leaves of the argument graph, use the arguments to reason forwards from the accepted and rejected statements, noting which arguments are applicable, because all of their premises hold, and which statements are acceptable, because the applicable arguments satisfy the statement’s proof standard, as assigned previously. This step is performed automatically by the Carneades software.
9. Critically evaluate the arguments by checking which conclusions are acceptable

given the arguments and by using the argumentation schemes to reveal and critically question any implicit premises.

The methodology is flexible. It does not require these steps to be performed in a strictly linear order. Rather, one can work in more iterative fashion, moving back and forth between these tasks as needed. For example, one could start out by modeling a single argument and its statements, adding further statements to the key list as necessary for modeling the remaining arguments.

In the next section, we apply the methodology sketched above to reconstruct and evaluate Judge McCarthy's arguments in his decision of *Popov v Hayashi*. The final section of the paper reflects on the utility of our methodology and tools and compares them to related prior work on modeling legal cases from the field of Artificial Intelligence and Law and other methods and tools for mapping and evaluating arguments, from the field of computational models of argument.

2 A Reconstruction of *Popov v Hayashi*

We assume the facts of *Popov v Hayashi* have been thoroughly presented elsewhere in this volume and will present only a brief summary here. The plaintiff, Alex Popov, and defendant, Patrick Hayashi, both attended as spectators a baseball game at PacBell Park in San Francisco on October 7, 2001. During the game, Barry Bonds, playing for the San Francisco Giants, hit his seventy third home run, breaking the previous record. The ball was hit into the stands of the arcade section, where Popov, Hayashi and many other fans had positioned themselves, armed with baseball gloves, hoping for just this event and a chance to catch the ball. Popov jumped to catch the ball and had it in his glove but was attacked by a crowd before he could gain complete control of the ball. The ball fell out of Popov's glove and rolled to a place where Hayashi was able to pick it up and put it in his pocket. Hayashi was not a member of the crowd which attacked Popov. Presuming the ball to be very valuable, Popov sued Hayashi, pleading causes of action for conversion and trespass to chattel.

The case was decided in the first instance by Judge Kevin M. McCarthy, for the Superior Court of California in San Francisco. The published opinion of the court has two main sections, presenting first an analysis of the facts found on the basis of the evidence brought before the court, followed by an analysis of the legal issues. It appears that the factual issues were decided by Judge McCarthy, not a jury.

Let us begin with the factual issues. There were two main factual issues in the *Popov* case: 1) Did Popov catch the ball? And 2) Was Hayashi guilty of any wrongdoing? In particular was Hayashi one of the persons who attacked Popov and prevented him from having a chance to complete his catch of the ball? To illustrate how Carneades can be used as a case management tool for mapping out and evaluating evidence, serving the same purpose as Wigmore diagrams [Wigmore, 1908, Gordon, 2007], it is sufficient to model the evidence for the first factual issue, as shown in Figure 2.

As shown in the figure, Popov submitted the following evidence to prove that he caught the ball: 1) A video taken by Josh Keppel, a cameraman positioned near the

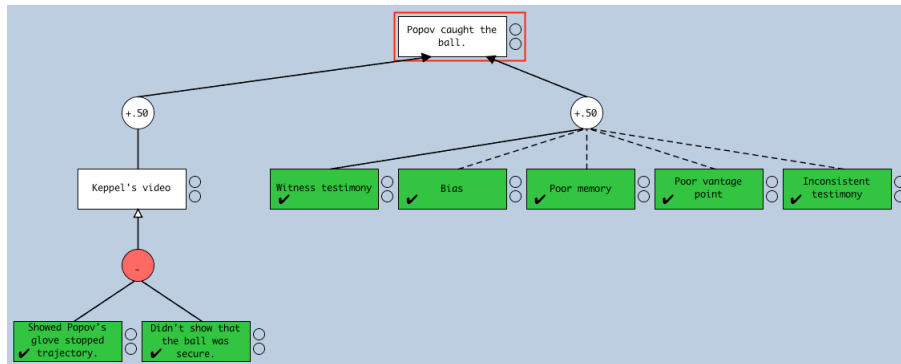


Figure 2: Would Popov have caught the ball?

arcade where Popov tried to catch the ball, and 2) the testimony of 17 witnesses. This evidence is modeled as two arguments pro Popov’s claim that he caught the ball. The statement label with the key “Keppel’s Video”, is intended to mean “Keppel’s video shows that Popov caught the ball.” The burden of proof in civil cases is preponderance of the evidence. In the model, each piece of evidence has been given the default weight of 0.5, on a scale from 0.0 to 1.0, similar to probability theory.³ The basic procedure for resolving factual issues is to aggregate the weights of the evidence pro and con the fact at issue. Interestingly, in this case no evidence was brought forward to show that Popov did not catch the ball. Thus there are no arguments con this issue in the model. But Popov failed to meet the preponderance of the evidence proof standard nonetheless. This is because arguments were brought forward which undermined this evidence. While the video did show that Popov’s glove stopped the trajectory of the ball, it did not show that the ball was secure. Thus Judge McCarthy decided the video did not show that Popov had caught the ball. Similarly, the testimony of the 17 witnesses was rejected as evidence tending to show that Popov caught the ball, for several reasons: some of the testimony was inconsistent, some of the witnesses were shown to be biased, some of the witnesses did not have a good vantage point and thus were not able to clearly observe the events, and some of the witnesses testified that they could not remember what happened, or at least not well. Popov’s claim that he caught the ball is left with no supporting evidence as a result. Judge McCarthy did not reject this claim, as being false, but simply left this issue open, i.e. undecided. In the diagrams, undecided statements are shown with white background; accepted statements are shown with a gray background, together with a check mark in the lower left corner of the box; and rejected statements are also shown with a gray background, but with an X in the lower left corner of the box. Since Popov, as the plaintiff, has the burden of proving all facts necessary to establish the elements of the causes of action he has pled, his failure to prove that he caught the ball will turn out, as we will see below, to be fatal for his legal claim that Hayashi converted the ball.

³Weights do not play a role in the legal arguments modeled below, since the proof standard used to resolve legal issues is dialectical validity, where weights are irrelevant.

We have modeled the counterarguments in two different ways, with a con argument rebutting the video evidence and by using *critical questions* of the argumentation scheme for witness testimony. [Walton, 2005, p. 13] listed the following critical questions for arguments from witness testimony:

1. Is what the witness said internally consistent?
2. Is what the witness said consistent with the known facts of the case?
3. Is what the witness said consistent with what other witnesses said?
4. Is there some kind of bias that can be attributed to the account given by the witness?
5. How plausible is the statement asserted by the witness?

In Carneades, critical questions are modeled as special types of premises, called exceptions and assumptions [Gordon et al., 2007]. Whether an exception or an assumption is appropriate depends on which party has the burden of proof for the statement once the question has been asked. For example, if the person who asked the bias question has the burden of proving the witness was in fact biased, then the bias question should be modeled as an exception. In our model of *Popov v Hayashi* we have assumed that all of these questions should be modeled as exceptions. Although it is not clear from the opinion whether Hayashi had the burden of proof for these questions, it is clear that Judge McCarthy decided that these questions were to be answered affirmatively. He found that the witnesses were in fact biased, inconsistent, etc. Had Popov had the burden of proof for these questions, we could have modeled them as assumptions which had been called into question. Then Popov would have had to prove that the witnesses were not biased, inconsistent, and so on. The testimonial evidence would have failed had Popov not met this burden of proof, without Judge McCarthy having to find, for example, that the witnesses were biased. Finally, notice that we have modeled the memory and vantage point counterarguments also as exceptions, even though these were not included in the list of critical questions in Walton's formulation of the scheme for arguments from witness testimony. Schemes provide guidance, helping people to ask relevant critical questions. This does not mean they are exhaustive. Other critical questions may also be relevant, depending on the situation.

Let us now turn to the legal issues. Judge McCarthy's analysis of the legal issues can be summarized as follows. The elements of the conversion and trespass to chattel were first presented. The trespass to chattel claim was easily dismissed, since Hayashi did not damage the ball. The conversion cause of action has two elements, ownership of the ball by Popov and the wrongful exercise of control ("dominion") over the ball by Hayashi. The precedent cases show two ways Popov could be found to own the ball, by having title or by having possession. He didn't have title, which left possession to check. Since Popov did not have complete control of the ball, having dropped it during the attack by the crowd, the *Pierson v Post* line of cases is relevant here, since in some of these cases possession was found even though the party did not have complete control of the property. But Judge McCarthy distinguished the facts of the Popov case from these precedents, by arguing that the concept of possession is contextual and depends

on the customs and conventions of the field or industry. Hunting and fishing have different customs than baseball. Possession in baseball, by custom, requires complete control of the ball. Popov had the burden of proving, with a preponderance of the evidence, that he had complete control, but failed to meet this burden of proof. But since Popov was prevented from trying to complete his catch of the ball by the attack of the crowd, Judge McCarthy was not happy to leave it at that. Using an argument from practical reasoning, i.e. a policy argument, with the aim of discouraging such violence at baseball games, Judge McCarthy created a rule stating a person has a qualified right to possession of an abandoned piece of property when he has taken sufficient steps to achieve possession which were interrupted by unlawful acts of others. Nonetheless, despite now having argued that Popov did have a sufficient ownership interest in the ball to sustain a cause of action for conversion, the conversion claim failed, because its second requirement, namely the wrongful exercise of dominion over the ball by Hayashi, was found to not be satisfied. Not only did Popov fail to prove that Hayashi had done anything wrong, but the court found, on the contrary, that Hayashi had done nothing wrong and was “a victim of the same bandits that attacked Mr. Popov.”⁴

Having proven neither of his two claims, conversion or trespass, one might think that Popov would have lost the case and gone home empty handed. But in Common Law jurisdictions, at least, judges have both the obligation and the power to reach a fair, equitable decision, balancing the interests of the parties, in particular when, as in this case, an application of the existing legal rules alone would fail to lead to an equitable result. This is a practical problem, where alternative possible courses of action are compared to see which alternative best promotes the value of equity. Judge McCarthy considered three alternatives: 1) giving the ball to Popov, 2) giving the ball to Hayashi, and 3) selling the ball and dividing the proceeds equally between Popov and Hayashi. Giving the ball to Popov would not have been fair to Hayashi, who did nothing wrong and had gained complete control and possession of the ball while Popov was not able to prove that he, Popov, had caught the ball. Giving the ball to Hayashi would not be fair to Popov, who had acquired a qualified right to possess the ball, because his attempt to catch the ball was interrupted by the illegal attack of the crowd. Judge McCarthy concluded that the claims of Popov and Hayashi to the ball were of equal quality, making a 50/50 division of the proceeds from the sale of the ball the only fair alternative.

In the rest of this section, McCarthy’s main legal arguments will be modeled using Carneades. We will then use this model to try to evaluate his arguments and reveal some potential weaknesses. Let’s begin with the two causes of action, conversion and trespass to chattel, shown in Figure 3.

The statement at the top of this figure is intended to mean something like “The plaintiff, Popov, has proven the elements of a cause of action against Hayashi which entitles him to the requested relief as a matter of law.” The line around the box just

⁴Incidentally, this finding renders Judge McCarthy’s proposed rule about a qualified right to possession being sufficient to meet the ownership requirement of the conversion cause of action *obiter dictum*, not relevant for the decision of the case and thus not binding precedent. According to Black [1979], *obiter dictum* is “an observation or remark made by a judge when pronouncing an opinion on a case, concerning some rule, principal or application of law, or the solution of a question suggested by the case at bar, but not necessarily involved in the case or essential for its determination.”

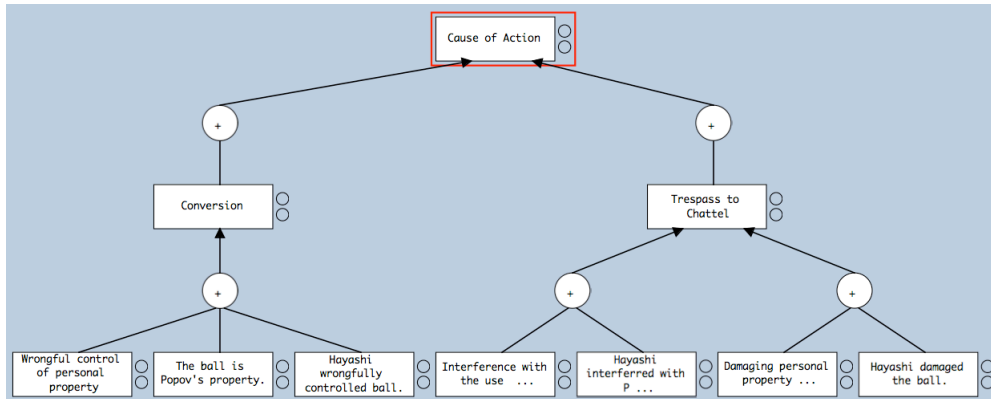


Figure 3: The Causes of Action

indicates that it has been selected and is the focus of our attention. The two causes of action claimed by Popov are modeled as arguments pro this top statement, each with a single premise naming the cause of action. The conversion cause of action is supported by an argument with three premises, a major premise stating a rule and two minor premises stating that the conditions of this rule are satisfied by the facts of this case. The major premise is intended to mean “Conversion is the wrongful exercise of dominion over the personal property of another.”. The two minor premises in the figure are intended to mean “The ball is the personal property of Popov.” and “Hayashi wrongfully exercised dominion over the ball.”.

Similarly, arguments are included in the diagram for two kinds of trespasses to chattel. The first argument states, in its major premise, that “Interference with the use of personal property is trespass to chattel.” and, in a minor premise, that “Hayashi interfered with Popov’s use of the ball.” Another minor premise, stating that the ball is the personal property of Popov, has been left implicit in this argument, as in Judge McCarthy’s expression of this argument in his opinion. We are only trying to reconstruct Judge McCarthy’s arguments at this point, not trying to evaluate them by asking critical questions that he did not ask. The second argument for trespass to chattel also has two premises, a major premise stating that damaging personal property is trespass to chattel and a minor premise stating that Hayashi damaged the ball. Here too the minor premise stating that the ball was Popov’s personal property has been left implicit. Both of these trespass to chattel arguments were dismissed summarily by Judge McCarthy, by noting that the plaintiff, Popov, had failed to claim, let alone prove, the minor premises: “In the case at bar, Mr. Popov is not claiming that Mr. Hayashi damaged the ball or that he interfered with Mr. Popov’s enjoyment of the ball. He claims instead that Mr. Hayashi intentionally took it from him and refused to give it back. This is not trespass to chattel.” So he immediately shifted his focus to the conversion cause of action.

In the model, we didn’t reject the minor premises of the trespass to chattel arguments as being false. Since Popov had the burden of proof for these facts, Judge McCarthy didn’t need to reject them in order for the trespass to chattel claim to fail. Had

the premises been rejected, they would have been displayed with a gray background together with an X in the lower lefthand corner. The white background indicates they are at issue and have been neither accepted nor rejected.

In analyzing the conversion argument, Judge McCarthy first supported its major premise, the rule, by citing a legal treatise, Witkin's Summary of California Law [1990], and a single case, *Fresno Air Service v Wood*⁵. In Toulmin's terms [Toulmin, 1958], the major premise expresses the *warrant* of the argument and these citations provide *backing* for the warrant. In Carneades, backing is modeled using further arguments, pro the major premise, as shown in Figure 4.

The premises of these arguments are shown with a gray background, together with a check mark, since they have been accepted by Judge McCarthy. The accepted and rejected statements are input to the Carneades system. They represent the assumptions of the person or persons, called the *audience*, from whose perspective the arguments are being evaluated, in this case Judge McCarthy. The upper "traffic light" to the right of the conclusion, stating the rule that conversion is the wrongful exercise of dominion over the personal property of another, is filled with gray to indicate that this conclusion is acceptable given these arguments. The acceptability of a statement and its logical complement (negation) are computed by Carneades and visualized with the two traffic lights. The top light shows the acceptability of the statement and the bottom light shows the acceptability of its complement. Acceptability is computed using the proof standard assigned to a statement, in this case dialectical validity. The dialectical validity standard is satisfied if there is at least one applicable argument pro the statement and no arguments con the statement are applicable. An argument is applicable only if all of its premises have been accepted or, if the statement is still undecided, acceptable. The rule is shown with a gray background together with a check mark, indicating that it has been accepted by Judge McCarthy. Had the statement not been acceptable, this decision would not have been justified by the arguments. For example, Judge McCarthy's decision to accept *Fresno Air Service v Wood* as backing for the rule was not supported by further arguments and thus lacks justification. However this lack of justification does not necessarily indicate a weakness in his argument. If Judge McCarthy's interpretation of *Fresno Air Service v Wood* is uncontroversial it probably does not require justification in order for his analysis of the Popov case to be persuasive.

Judge McCarthy addressed next the issue of whether or not the ball was Popov's personal property, which is one of the conditions of the conversion cause of action and thus also one of the minor premises of the conversion argument. It is interesting that Judge McCarthy chose to address this minor premise first, since as we will see it requires a rather involved analysis to resolve, rather than the other minor premise, about Hayashi having wrongfully exercised dominion over the ball. Judge McCarthy found that Hayashi "committed no wrongful act". On the contrary, Hayashi was found to be "a victim of the same bandits that attacked Popov". In footnote 5 of the opinion there is some discussion of the evidence of wrongdoing by Hayashi, including a video tape purportedly showing Hayashi to be biting the leg of someone and some witness testimony, but Judge McCarthy concluded the evidence was unconvincing and insufficient. Had Judge McCarthy addressed this issue first in his opinion, he could have omitted

⁵*Fresno Air Service v Wood*, (1965) 232 Cal. App. 2d 801, 806

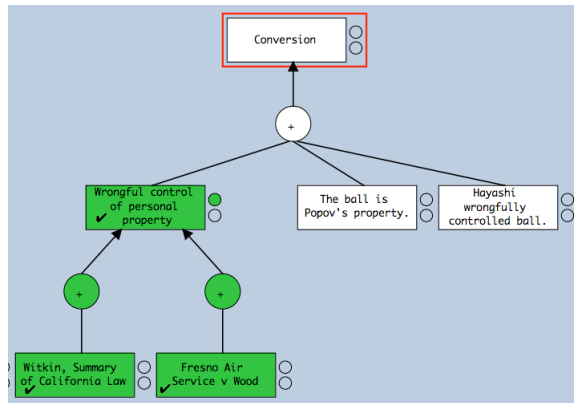


Figure 4: Backing of the Conversion Warrant

his lengthy discussion of the ownership issue as not being relevant. But, as we will see, his main conclusion of this analysis, that Popov had a qualified right to possession of the ball sufficient to meet the ownership condition of the conversion cause of action, was also important for his equity arguments later in the opinion.

Again, Judge McCarthy’s analysis of the ownership issue is rather involved and the most detailed part of his opinion. He begins by first identifying three means of proving ownership: “Conversion does not exist, however, unless the baseball rightfully belongs to Mr. Popov. One who has neither title nor possession, nor any right to possession, cannot sue for conversion.” Once again he backs this rule by citing Witkin [1990] and a case, this time Metropolitan Life Insurance Company v San Francisco Bank.⁶ These alternative arguments are shown in Figure 5. Their major premises (rules) and the arguments backing these rules, by citing the above authorities, have been left implicit to save space.

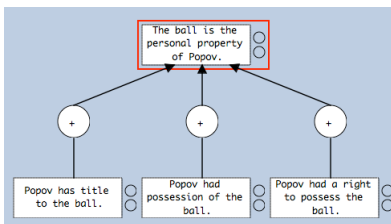


Figure 5: Ownership of the Ball

The title argument is not pursued further by Judge McCarthy, presumably because Popov did not claim to have title to the ball, but rather only possession. Interestingly, to help him resolve the possession issue, Judge McCarthy requested the advice of four “distinguished law professors”. Not surprisingly, perhaps, these professors could not

⁶Metropolitan Life Insurance Company v San Francisco Bank. (1943) 58 Cal. App. 2d 528, 534

agree on a definition of possession. Professor Bernhardt and Professor Brown argue that possession requires physical control of the property and the subjective intent to control the property. But Professor Bernhardt, in agreement with Professor Finkelmann, points out that physical control is a guideline, not a hard condition, which has been softened by a line of precedent cases, including *Pierson v Post*⁷ and *Young v Hutchinson*⁸. Based on an analysis of these precedents, Bernhardt and Finkelmann proposed a rule stating that possession has been achieved if “the actor is actively and ably engaged in efforts to establish complete control” and “such efforts are reasonably calculated to result in unequivocal dominion and control at some point in the near future”. Professor Gray argued for a stricter rule in this case, based on custom in baseball and more in line with the general rule requiring physical control, in which a “ball is caught if the person has achieved complete control of the ball at the point in time when the momentum of the ball and the momentum of the fan trying to catch the ball ceases.” Judge McCarthy distinguished *Pierson v Post* and the other “fish and animal” cases by arguing that rules of possession are “contextual in nature” and “influenced by the custom and practice of the industry”. He followed Prof. Gray’s opinion regarding the custom and practice in baseball and decided that the evidence submitted by Popov was insufficient to prove that he had achieved full control of the ball by the preponderance of evidence proof standard.

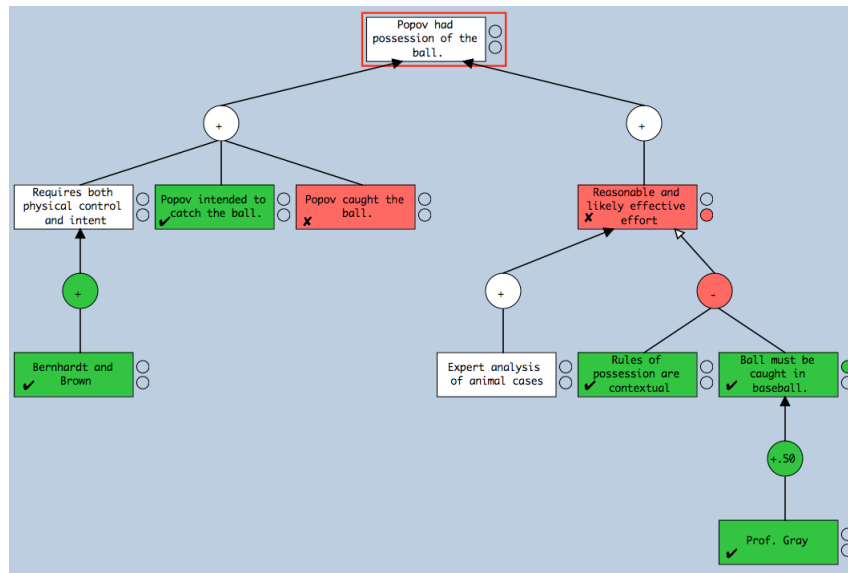


Figure 6: Possession of the Ball

The arguments about the possession issue are modeled, in somewhat simplified form, as shown in Figure 6. We’ve modeled Judge McCarthy’s argument distinguishing Popov from the animal cases as a con argument *undercutting* the rule proposed by

⁷*Pierson v Post*, 3 Caines R. (N.Y. 1805)

⁸*Young v Hutchinson*, 6 Q.B. 606 (1844)

Professor Bernhardt and Professor Finkelmann, based on their analysis of the animal cases. Notice how undercutters are modeled in Carneades as arguments against the major premise of an argument, or the applicability of the major premise to the current case, whose propositional content of the major premise expresses the rule applied in the argument. That is, undercutters are modeled as premise attacks. (To be clear, not all premise attacks model undercutters.) In the argument undercut, only the major premise, for the proposed rule about reasonable efforts to gain control which are likely to be successful in the near future being sufficient to establish possession, is shown in the figure. Since this rule was rejected in this case, the minor premises are irrelevant. The “expert analysis of animal cases” argument could be expanded into a more complex argument which makes the case-based analysis of the animal cases of Professors Bernhardt and Finkelmann’s explicit, but since Judge McCarthy distinguished Popov from this line of cases the details are not necessary for understanding his decision. As before, statements which have been accepted by Judge McCarthy are shown with gray backgrounds together with a check mark in the lower lefthand corner. Figure 6 also illustrates for the first time some rejected statements, shown with gray backgrounds and an X in the lower lefthand corner. When all the premises of an argument hold, i.e. are either accepted or, if at issue, acceptable, the argument is applicable. In the diagrams, arguments are displayed as circles. If an argument is applicable, its circle is filled with gray. Inapplicable arguments are shown with a white background. Again, the applicability of arguments and the acceptability of statements are computed by the Carneades system. Judge McCarthy’s decision to reject the proposed “reasonable and likely effective effort” rule for possession, proposed by Professors Bernhard and Finkelmann, is (formally) justified, as indicated by the filled bottom traffic light to the right of the rule, since it is supported by an applicable con argument.

The evaluation of Popov’s conversion claim is not over with the decision to reject the claim of possession. Recall, as shown in Figure 5, that Judge McCarthy identified three ways to prove ownership of the ball sufficient to sustain the conversion cause of action: title, possession and a right to possession. Up until now the first two alternatives have been dispensed with. Judge McCarthy turned his attention to the third possibility next by asking whether Popov had acquired a right to possession in the ball. Using practical reasoning, Judge McCarthy concluded that Popov had acquired such a right. The model in Carneades of this argument is shown in Figure 7. The full rule adopted by Judge McCarthy is “When an actor takes significant but incomplete steps to achieve possession of a piece of abandoned property and the effort is interrupted by the unlawful acts of others, the actor has a legally cognizable pre-possessory interest in the property ... which can support a cause of action for conversion.” The rule is shown in an abbreviated form in the figure. Judge McCarthy supported this rule with two arguments from practical reasoning. The first, shown in the diagram, is that the rule would achieve the goal of inhibiting such attacks by mobs at baseball games, which would promote the value of security. (See Atkinson et al. [2005] for an in-depth discussion of the argumentation scheme for practical reasoning we are using here.) The second argument from practical reasoning, not shown, is that this rule promotes fundamental fairness.

One of the critical questions one can ask to challenge arguments from practical reasoning is whether some other actions are available for achieving the same goals, or

promoting the same values. In a footnote of his opinion, Judge McCarthy responded to a critical question of this kind by Professor Gray, who suggested that such attacks could be inhibited by suing the attackers for damages. But Judge McCarthy countered this argument by pointing out that it would be impractical to prove which of the persons in the crowd participated in the attack. Plaintiffs in such cases would usually not be able to meet their burden of proof. Thus this alternative would not achieve the goal of inhibiting violence as effectively as Judge McCarthy’s proposed rule. To save space, and also because they are not necessary to illustrate features of Carneades, these arguments have not been included in the model.

Also not illustrated is Judge McCarthy’s justification for resorting to practical reasoning in this case. We use the term “resorting” because typically judges are wary of using practical reasoning, since it raises controversial issues about the separation of powers between the judiciary and legislature. While typically judges are supposed to apply the (positive) law enacted by the legislature, not make policy decisions or enact laws, judges in Common Law countries (at least) have long had the power, and perhaps the responsibility, to do justice and decide cases in a fair way which promotes equity. It is not clear to us whether this power extends to cases where an equitable solution would be inconsistent with applicable legislation, but Judge McCarthy did not address this issue, and presumably did not need to address this issue, since there is no indication that the rule he adopted was inconsistent with applicable legislation. Rather, his rule appears to fill a gap in the legislation.

As shown in the figure, not only did Judge McCarthy accept his proposed rule, but he also decided that all of its conditions were met by the facts of the case. Popov did make a sufficient effort to try to catch the ball which was interrupted illegally by the attacks of the mob. The evidence supporting these factual findings are not shown in the diagram but are presented in the written opinion. Judge McCarthy did not try to justify his claim that attacks of this kind are illegal, presumably because the law is clear and uncontroversial on this point.

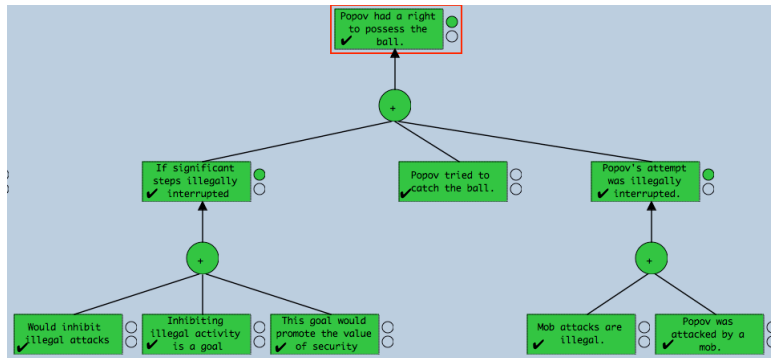


Figure 7: Popov’s Right to Possession of the Ball

Somewhat surprisingly, after going to all the trouble to construct a new rule giving Popov an ownership interest in the ball sufficient to sustain the conversion cause of action, Judge McCarthy next summarily dismissed the conversion claim by deciding

that Popov had failed to prove, with a preponderance of the evidence, that Hayashi had wrongfully “exercised dominion” over the ball. Recall that such a wrongful exercise of control over the personal property is a further requirement of conversion, as shown in Figure 3. On the contrary, Judge McCarthy decided that Hayashi had done nothing wrong and was also a victim of the attacks of the crowd. Since Popov, the plaintiff, failed to prove either of his claims, one might think that Judge McCarthy would end his opinion at this point and declare Hayashi the winner of the case. The plaintiff has the burden of proof. The parties are not in symmetric positions. The defendant, Hayashi, did not need to prove that he had a right to possess and keep the ball. He only needed to produce arguments and evidence sufficient to prevent Popov from proving his case. And Hayashi succeeded in meeting this goal fully. Nonetheless, Judge McCarthy was not content to stop here, but went on to consider alternative solutions to the problem of how to achieve a fair result in this case. Our model of his arguments in Carneades are shown in Figure 8.

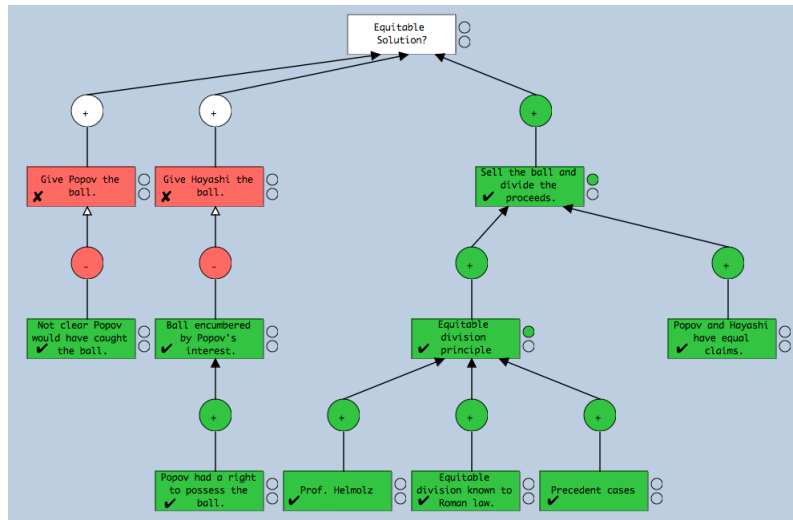


Figure 8: Trying to Find an Equitable Solution

We have modeled this part of Judge McCarthy’s opinion as a deliberation problem, in the style of issue-based information systems [Rittel and Webber, 1973]. Many argument mapping tools have been based on the IBIS model [Conklin and Begeman, 1988, Gordon and Karacapilidis, 1997, Selvin et al., 2001]. The basic building blocks of the IBIS model are issues, positions and pro and con arguments. Issues represent a problem to be solved. For example, the problem of Judge McCarthy is trying to solve is how to decide the Popov case in an equitable way. In Figure 8, we’ve represented this problem as a question, which is intended to mean something like “Does an equitable solution exist in this case?”. Strictly speaking, the formal model underlying Carneades does not support questions, but only declarative sentences, called statements. Nonetheless, such questions can be given a declarative interpretation in first-order logic, using existential quantifiers. That is, we interpret this question to mean the statement “There exists an

equitable solution in this case.” Positions in the IBIS model of deliberation are the proposed alternative solutions to the problem. In Carneades positions are represented as alternative pro arguments for the statement at issue. For resolving the equity issue, Judge McCarthy considered three alternatives: 1) giving the ball to Popov, 2) giving the ball to Hayashi, and 3) selling the ball and dividing the proceeds equally between Popov and Hayashi. The final element of the IBIS model, pro and con arguments, are directly supported by Carneades. Judge McCarthy’s argument con the first alternative, giving the ball to Popov, is that since Popov did not prove that he caught the ball, giving the ball to him would be unfair to Hayashi. Judge McCarthy’s argument con the second alternative, giving the ball to Hayashi, is that the since Hayashi’s ownership of the ball was encumbered by Popov’s prepossessory interest in the ball, analogous to a “cloud” on a title to real property, giving Hayashi the ball would be unfair to Popov. The final alternative considered, selling the ball and dividing the proceeds equally, was the fairest alternative in Judge McCarthy’s opinion. Since Popov and Hayashi had equally good claims to the ball, it seems fair that they should be awarded equal amounts. This basic equity argument seems rather obvious and intuitive. In typical deliberations this argument may have been sufficient to justify a decision to prefer this position. But since the case at hand is a legal case before a court, Judge McCarthy went further by also providing an argument to support his legal authority to choose this solution, based on a principal of equitable division. Three arguments were put forward as backing for this equitable division principal: 1) an argument from authority, citing a law review article by Professor Helmolz which proposed applying the principal of equitable division to resolve disputes between finders of lost property, 2) an argument from legal tradition, pointing out that the principal of equitable division has its roots in ancient Roman law, and 3) by citing two precedent cases in which the principal of equitable division had been applied.

Three of the four arguments pro and con the alternative positions in Judge McCarthy’s deliberation about how to find an equitable solution are arguments from practical reasoning. But to see this clearly it would be necessary to reveal some premises which have been left implicit, for lack of room in the diagram. For example, in the argument against giving Popov the ball, the major premise is missing. This premise would state that giving one person exclusive rights to personal property when someone else has an equally good claim to the property would undermine, not promote, the value of equity. Similarly, in the argument pro dividing the property equally, the major premise, stating that dividing property equally among persons with equally good claims to the property promotes the value of equity, is missing. But as evidenced by the legal argument about the authority of a judge to divide property in such cases, clearly not all arguments in a deliberation need be arguments from practical reasoning.

This completes our model in Carneades of Popov v Hayashi. The model includes 33 arguments, using the following argumentation schemes:

- 1 Argument from witness testimony (for 17 witnesses)
- 1 Argument from circumstantial evidence (for the video)
- 13 Arguments from legal rules (not statutes, which are one way to back rules, but for all rules, whatever their backing)

- 1 Argument from legal principle (equitable division)
- 5 Arguments from secondary authority (professors, treatises, etc.)
- 2 Arguments from precedent cases (including arguments from an analysis of a line of cases, not just citations to particular cases)
- 4 Arguments from practical reasoning
- 3 Arguments from positions (i.e. proposed solutions to problems, as in IBIS)
- 1 Argument from tradition (Roman law)
- 2 ad hoc arguments (the first undermining the video evidence by arguing the video didn't show the ball was secured and the second arguing that Popov's right to possession encumbered Hayashi's interest in the ball)

To conclude this section on our model of *Popov v Hayashi*, let us now try to use the model to evaluate and criticize Judge McCarthy's opinion. First of all, Judge McCarthy seems to have done a good job of justifying his decision. His arguments are seamless. Both his rejection of Popov's two claims, for conversion and trespass to chattel, and his decision to have the ball sold and the proceeds divided, are justified, at least formally, by the arguments in the opinion. Nonetheless, our reconstruction of his arguments in Carneades has helped us to reveal some weaknesses in the opinion. For example, in Judge McCarthy's presentation of his analysis of the testimonial evidence of the 17 witnesses, he provides an aggregated summary of his analysis, without making explicit which critical questions, such as bias, were applied to undermine the testimony of each witness separately. This makes it impossible for the reader to form his own opinion about the testimony of each witness. Perhaps this information can be recovered from the transcript of the trial. But probably the major weakness of Judge McCarthy's opinion is the rather uncritical way he applied the argumentation scheme for practical reasoning. Since he applied this scheme himself, when writing his opinion, there was no respondent to challenge these arguments by asking critical questions of the scheme for practical reasoning. Here are some possible critical questions of the scheme for practical reasoning [Walton, 2006, p. 330]:

1. Are there alternative means to achieve the goal?
2. Is the goal realistic?
3. Are there other goals which might conflict with the stated goal?
4. Would the proposed solution have any negative consequences (side effects) which should be considered?
5. Is the proposed solution the best or most acceptable alternative?

While Judge McCarthy did consider three alternative proposals for achieving an equitable result in this case, he did not consider, at least in his written opinion, potential negative side effects or conflicting goals or values, other than equity. If the decision

had been appealed, presumably the appellate judges would have take the opportunity to consider such questions.

From a legal perspective, it also seems somewhat surprising how little use Judge McCarthy made of primary legal sources (statutes and cases) and, conversely, how extensively he relied upon secondary sources, such as Witkin’s Summary of California law and the legal opinions of various professors. Even the legal analysis of the animal cases was delegated to some of these professors, which is why the argument from these cases was classified above as an argument from secondary authority, rather than as an argument from precedent.

3 Discussion

Thus far in this paper we have demonstrated how Carneades can support the tasks of reconstructing and evaluating arguments, using Judge McCarthy’s opinion of the Popov v Hayashi case as an example. In this final section of the paper, we would like to critically evaluate Carneades itself, and ask ourselves how much support it really provides for this task, compared to some other available tools and methods.

First of all, let us emphasize that the Carneades software was in fact used for the analysis of the Popov v Hayashi case presented here. All of the figures are from screen shots of the software.⁹ Could we have achieved the same result without using Carneades? Yes, surely. For example, we could have applied Walton’s methodology manually, without the support of any software tools. But we needn’t be that ascetic. There is much generic software, with no special support for argumentation, which could be useful in this context, starting with text editors and drawing tools. More useful still would be outline processors, and mind-mapping tools, but these are typically limited to modeling trees, not more general graphs. Argument graphs, in general, are not limited to trees. But this limitation can be overcome by simply duplicating some nodes in the tree.

For some reason, mindmaps have not been often used, to our knowledge, for modeling arguments. Most people seem to prefer “box and arrow” diagrams in the Beardsley/Freeman style [Beardsley, 1950, Freeman, 1991]. Carneades diagrams are similar, although there are some important differences. For example, in Carneades diagrams there is only a single node for each proposition and its logical complement. In the Beardsley/Freeman style of diagramming, the statement and its complement are represented as two nodes, connected with a “refutation” link. Also, there are no con arguments in the Beardsley/Freeman style. Rather con arguments are represented as arguments pro the refutation of the conclusion.

Araucaria is probably the most well known open source software application to support argument reconstruction via argument diagramming [Reed and Rowe, 2004].¹⁰ Araucaria currently provides more support than Carneades for argumentation schemes, but we are working on overcoming this disadvantage. Carneades does provide a way

⁹The screen shots have been edited slightly to overcome the lack of color printing, by adding check marks and Xs to accepted and rejected statements, respectively.

¹⁰<http://www.computing.dundee.ac.uk/staff/creed/araucaria/>

to enter the name of the argumentation scheme applied for each argument in the diagram, but Araucaria goes further by providing a way to match the premises of a scheme against the premises of an argument, which is very useful for helping to reveal missing or incorrect premises. On the other hand, Araucaria, unlike Carneades, does not currently provide support for automatically labeling arguments or statements using a formal model of argument. Araucaria can be used to manually label statements, but it is completely the user's responsibility to do this in some coherent way.

When we claim that Carneades supports argument reconstruction, we mean only that it, like Araucaria, provides software for modeling and visualizing arguments and relationships between arguments. Such tools are useful for representing and comparing interpretations of natural language texts. Current research in the field of computational linguistics may eventually lead to tools which can provide additional support for argument reconstruction [Mochales and Leven, 2009].

As demonstrated in our reconstruction of Judge McCarthy's deliberations about how to decide *Popov v Hayashi* in an equitable way, Carneades can be used to construct IBIS diagrams. Probably the leading open source IBIS tool at the moment is Compendium [Selvin et al., 2001].¹¹ Whereas Compendium is a robust, mature and well-documented tool, Carneades is still a research prototype, in an early stage of development. But Compendium, like Araucaria, lacks a formal foundation enabling the software to provide support comparable to Carneades for argument evaluation.

There are many other argument mapping tools available, including some commercial ones, but this is not the place for a comprehensive market overview. Let us just say that, to our knowledge, few of them provide support for argument evaluation comparable to Carneades. Some exceptions include Hermes [Karacapilidis and Papadias, 2001], which is based on Zeno [Gordon and Karacapilidis, 1997], ArguMed [Verheij, 2005] and, most recently, Dungere [South et al., 2008], which visualizes abstract argumentation frameworks [Dung, 1995]. But precisely because abstract argumentation frameworks are abstract, Dungere provides no way to represent the premises and conclusions of arguments or to visualize how premises and conclusions of arguments are connected or related.

A very interesting recent web-based system for argument visualization is ArguNet¹² In ArguNet, argument graphs are diagrammed in a compact way at a higher level of abstraction, comparable in some ways to Dung abstract argumentation frameworks, while still providing a way to represent the micro-structure of arguments. ArguNet is based on classical logic and does not, to our knowledge, provide support for defeasible argumentation or proof standards, unlike Carneades, as needed for modeling legal arguments.

As in Araucaria, Carneades' support for assigning argumentation schemes to arguments is useful for evaluating arguments, even after they have been reconstructed, modeled and visualized. Argumentation schemes make it possible to identify implicit premises in an argument and ask the corresponding critical questions.

The arguments in Judge McCarthy's opinion of *Popov v Hayashi* were modeled at least once previously, prior to the articles in this volume [Wyner et al., 2007]. This

¹¹<http://compendium.open.ac.uk/institute/index.htm>

¹²<http://www.argunet.org/debates/>. See also [Betz, 2009].

reconstruction was based primarily on their prior work on valued-based argumentation systems [Bench-Capon, 2003] and modeling practical reasoning [Atkinson et al., 2004], but it did make use of several argumentation schemes, in addition to the scheme for practical reasoning, including arguments from witness testimony and defeasible modus ponens. However the arguments from argumentation schemes for reasoning about evidence, such as witness testimony, were not modeled. Rather, the paper only describes how such schemes are used to reason about evidence and presents the results of this manual analysis as a list of facts. The analysis of the legal arguments proceeds by first modeling a set of defeasible rules which allow intermediate conclusions to be derived from the facts and then using these rules to construct the arguments in the opinion. Finally, the arguments are evaluated by asserting attack relations between these arguments to construct a Dung abstract argumentation framework. The attack relations have been derived from a formal model of relationships between arguments constructed from rules. The final part of Judge McCarthy’s opinion, where he deliberates about how to reach an equitable decision, is modeled using a value-based argumentation framework. However, while this model clarifies why it would not be justified to award the ball to either Popov or Hayashi, it does not, unlike our reconstruction in Carneades here, cover Judge McCarthy’s justification for selling the ball and dividing the proceeds equally between the parties. Moreover, their reconstruction was done manually, with no support from a software tool for their formal methods.

To conclude, we have illustrated Carneades’ support for argument reconstruction, evaluation and visualization, by modeling most of the factual and legal arguments in *Popov v Hayashi*, and compared Carneades to prior related work on argumentation tools and methods. But this article has not presented a comprehensive overview of the Carneades system. In addition to argument reconstruction, evaluation and visualization, Carneades also provides support for other use cases shown in Figure 1, especially argument construction from knowledge bases consisting of models of ontologies, rules and cases, using formal models of several argumentation schemes, interpreted as methods for constructing arguments [Gordon and Walton, 2009]. To use a knowledge base to generate arguments automatically, the knowledge of the domain would need to be modeled at a finer level of granularity than we have used here. This will often not be practically feasible, due to the so-called “knowledge acquisition bottleneck”. When this is not feasible, Carneades can still be used as a tool for constructing arguments, as a more advanced kind of outliner, mind mapper or idea processor, with particular support for argumentation. In the legal field, there is a new generation of commercial case-management tools on the way, which are designed to assist lawyers with the task of constructing and evaluating arguments.¹³ One can imagine that in the future judges will use tools like Carneades to draft their opinions in the first place, not just to reconstruct arguments, after the fact, as we have tried to do here.

¹³In Germany, for example, see KnowledgeTools (<http://www.knowledgetools.de>), FallSoft (<http://www.fallsoft.de/>) and Normfall (<http://www.normfall.de/>).

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References

- Katie Atkinson, Trevor Bench-Capon, and Peter McBurney. Justifying practical reasoning. In *Proceedings of the Fourth International Workshop on Computational Models of Natural Argument (CMNA)*, pages 87–90, Valencia, Spain, 2004. ECAI.
- Katie Atkinson, Trevor Bench-Capon, and Peter McBurney. Arguing about cases as practical reasoning. In *Proceedings of the 10th International Conference on Artificial Intelligence and Law*, pages 35–44, Bologna, Italy, 2005.
- Monroe C. Beardsley. *Practical Logic*. Prentice Hall, New York, 1950.
- Trevor Bench-Capon. Persuasion in practical argument using value-based argumentation frameworks. *Journal of Logic and Computation*, 13(3):429–448, 2003.
- Gregor Betz. Evaluating dialectical structures. *Journal of Philosophical Logic*, 38(3): 283–312, 2009.
- Henry Campbell Black. *Black’s Law Dictionary*. West Publishing Co., 1979.
- J. Conklin and M. Begeman. gIBIS: a hypertext tool for exploratory policy discussion. *ACM Transactions on Office Information Systems*, 6(4):303–331, 1988.
- Phan Minh Dung. On the acceptability of arguments and its fundamental role in non-monotonic reasoning, logic programming and n-person games. *Artificial Intelligence*, 77(2):321–357, 1995. ISSN 0004-3702.
- James B. Freeman. *Dialectics and the Macrostructure of Arguments: A Theory of Argument Structure*. Walter de Gruyter, Berlin / New York, 1991.
- Thomas F. Gordon. Visualizing Carneades argument graphs. *Law, Probability and Risk*, 6(1-4):109–117, 2007.
- Thomas F. Gordon and Nikos Karacapilidis. The Zeno argumentation framework. In *Proceedings of the Sixth International Conference on Artificial Intelligence and Law*, pages 10–18, Melbourne, Australia, 1997. ACM Press.
- Thomas F. Gordon and Douglas Walton. Pierson vs. Post revisited — a reconstruction using the Carneades Argumentation Framework. In Paul E. Dunne and Trevor Bench-Capon, editors, *Proceedings of the First International Conference on Computational Models of Argument (COMMA 06)*, Liverpool, 2006. IOS Press.
- Thomas F. Gordon and Douglas Walton. Legal reasoning with argumentation schemes. In Carole D. Hafner, editor, *12th International Conference on Artificial Intelligence and Law (ICAIL 2009)*, New York, NY, USA, 2009. ACM Press.

- Thomas F. Gordon, Henry Prakken, and Douglas Walton. The Carneades model of argument and burden of proof. *Artificial Intelligence*, 171(10-11):875–896, 2007.
- N. Karacapilidis and D. Papadias. Computer supported argumentation and collaborative decision making: the HERMES system. *Information systems*, 26(4):259–277, 2001.
- Raquel Mochales and Aagje Leven. Creating an argumentation corpus: do theories apply to real arguments?: a case study on the legal argumentation of the echr. In *ICAIL '09: Proceedings of the 12th International Conference on Artificial Intelligence and Law*, pages 21–30, New York, NY, USA, 2009. ACM.
- Chris A. Reed and Glenn W.A. Rowe. Araucaria: Software for argument analysis, diagramming and representation. *International Journal of AI Tools*, 13(4):961–980, 2004.
- Horst W.J. Rittel and Melvin M. Webber. Dilemmas in a general theory of planning. *Policy Science*, 4:155–169, 1973.
- Albert Selvin, Simon Buckingham Shum, and et. al Maarten Sierhuis. Compendium: Making meetings into knowledge events. In *Knowledge Technologies 2001*, Austin, Texas, March 2001.
- M. South, G. Vreeswijk, and J. Fox. Dungine: A java dung reasoner. In *Proceeding of the 2008 conference on Computational Models of Argument: Proceedings of COMMA 2008*, pages 360–368. IOS Press, 2008.
- Stephen E. Toulmin. *The Uses of Argument*. Cambridge University Press, Cambridge, UK, 1958.
- Bart Verheij. *Virtual Arguments*. TMC Asser Press, The Hague, 2005.
- Douglas Walton. *Argumentation Methods for Artificial Intelligence in Law*. Springer, 2005.
- Douglas Walton. *Fundamentals of Critical Argumentation*. Cambridge University Press, Cambridge, UK, 2006.
- John H. Wigmore. *A Treatise on the System of Evidence in Trials at Common Law: Including the Statutes and Judicial Decisions of all Jurisdictions of the United States*. Little, Brown and Company, Boston, Massachusetts, USA, 1908.
- B.E. Witkin. *Summary of California Law*. Bancroft-Whitney Co., 1990.
- A. Wyner, T. Bench-Capon, and K. Atkinson. Arguments, values and baseballs: Representation of Popov v. Hayashi. *Legal knowledge and information systems. JURIX*, pages 151–160, 2007.