Wigmore (1931) thought that there was a science of proof underlying legal reasoning. He thought this science of proof was inductive. Nowadays there is much controversy, and indeed much skepticism on the part of those in the legal profession about modeling legal reasoning as inductive using the Bayesian calculus to attach probability values to statements and evaluate legal reasoning using conditional probability (Tillers, 1989). In the meantime, argumentation-based technology has provided qualitative methods that can be used to identify, analyze and evaluate arguments. In particular, argumentation schemes, standardized argument patterns different from the familiar deductive and inductive models of reasoning, have proved useful for this purpose (Wyner and Bench-Capon, 2007). These developments have lent support to Wigmore’s view that there is a science of proof underlying legal reasoning different from deductive logic (Sartor, 2005; Prakken, 2005, 2006). In this chapter is shown how recent advances in argumentation show the value of modeling legal reasoning in this new way.

In this chapter legal reasoning is divided into two broad categories, (1) the kind of reasoning that applies to rules to cases and (2) the kind of reasoning used to determine what the facts of a case are. In this chapter it is shown how to apply several centrally important argumentation schemes to a procedural sequence of case-based reasoning in which there is a successive refinement of cases. This sequence has an opening stage where the ultimate probandum is stated, an argumentation stage where arguments on both sides are put forward, and a closing stage. It will also be shown that it is necessary to distinguish between explanation and argument and to better appreciate the role of explanation in legal reasoning. As will be shown, inference to the best explanation is another type of reasoning commonly used in legal argumentation and important for understanding how it works (Josephson and Josephson, 1994).

The first section studies the kind of reasoning that applies rules to cases in law, including the following forms of reasoning: argument from an established rule, argument from a verbal classification, and argument from precedent. By using an example from a Supreme Court case summary, it has shown how all three kinds of reasoning can be combined into a chain of reasoning that represents the structure of the evidence used to support an alternate conclusion to be proved in a case. In this section it is shown how rule-based reasoning of this kind is more complex than it might initially seem. One reason is that reasoning from precedent depends on argument from analogy. Another reason is that as rules are applied to cases and analogies are made from a precedent case to a given case, the rules need to be continually modified as they are re-applied to the series of cases. The second section introduces the argumentation scheme for argument from analogy, shows how it is based on a notion of similarity between pairs of cases, and shows how case-based reasoning is based on a chain sequence of similarity reasoning by analogy in which cases are successively refined over the continuing sequence. The third section discusses the distinction between reasoning and argument. The following forms of reasoning are analyzed and discussed: practical reasoning, value-based practical reasoning, reasoning from lack of evidence, abductive reasoning, and argument from perception. The fourth section extends the analysis of two forms of reasoning that draw from inferences from sources, argument from witness testimony and argument from expert opinion. The fifth section shows how the structure of reasoning exhibited in the first four sections is that of defeasible logic. The sixth section shows how the notion of proof, including the notions of standard of proof and burden of proof,
need to be defined within a procedural context of argumentation that has the three main stages stated above. The final section contains the conclusion.

1. Forms of Reasoning by Applying Rules to Cases

   Legal Reasoning is often visibly based on a form of inference called argument from an established rule in the argumentation literature (Walton, Reed and Macagno, 2008, 343).

   **Major Premise:** If carrying out types of actions including the state of affairs $A$ is the established rule for $a$, then (unless the case is an exception), $a$ 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 $A$.

In this form of reasoning, $a$ is an agent that is capable of carrying out goal-directed actions and recognizing the consequences of actions. An agent also has the capability of feedback, that is, the capability of changing its actions depending on their perceived consequences. This form of reasoning also contains the assumption that the agent has a knowledge base containing a set of established rules. The old idea of mechanical jurisprudence considers the application of rules to cases as a straightforward application of deductive reasoning. The new approach of artificial intelligence and law sees the agent (judge or trier) as applying rules that can be defeated or overruled by exceptions as new evidence into the evidence in its knowledge base.

Legal positivists, for example (Hart, 1961), see law as consisting of two kinds of legal rules. The primary rules are the legal norms that regulate the activity of citizens and other persons. The secondary rules represent procedural norms that regulate the processes whereby the legislatures and courts put the primary legal rules into place and modify and apply them. But Hart recognized that both kinds of legal rules are inherently defeasible, meaning they admit of exceptions.

The term ‘defeasible’ comes from medieval English contract law. It referred to a contract that has a clause in it that could defeat the contract in a case the circumstances of the case fit the clause. This meaning is now broadened to include the notion of a defeasible rule, a rule that is open to exceptions. Hart, in his famous paper ‘The Ascription of Responsibility and Rights’ (1949; 1951), extended the usage of this term even further by writing about defeasible concepts. His most famous example is from The Concept of Law (1961). Consider the rule that no vehicles are allowed in the park. This rule could be defeated by special circumstances, for example during a parade, but it could also be defeated because of the open texture of the concept of a vehicle. Even though a car is classified as a vehicle, and would be excluded from the park, it may be debatable whether other objects like a bicycle or a skateboard also fit into the same classification.

Consider the case of the drug-sniffing dog (Brewer, 1996, Weinreb, 2005). Suppose 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 so, the evidence so obtained is not admissible as evidence. The problem is that the concept of a search is defeasible and law cannot define it by means of a set of necessary and sufficient conditions for closed to future revision because new cases may arise. Instead of providing closed essential definitions that give necessary and sufficient conditions, the best that can be done is to provide rules that may give necessary or sufficient conditions by indicating what types of things are included or excluded generally under the concept.

Weinreb (2005, 24) discussed two examples of such rules. One is the rule that if a police officer opens luggage and then observes something inside the luggage, the information collected
is classified as a search. This is a narrow rule because it applies only to luggage, but it may still offer some helpful guidance in a case. The other is the rule that 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 classified as a search. This rule is more general, but depends on the meaning of the prior concept of an intrusion on the person, other concepts like that of taking possession of something or interfering with the use of something. These terms will, of course, also be open-textured and could possibly be subject to disputation. Questions arise quite often concerning how actions, events and objects should be properly classified. In the example where the trained dog sniffs luggage left in a public place and signals to the police that it contains drugs, the question is whether this event should be classified as a search according to the Fourth Amendment?

Arguing from a legal classification is a special form of reasoning in its own right. The scheme following scheme represents argument from verbal classification (Walton, Reed and Macagno, 2008, 319). Here the constant $a$ represents an individual that can be an object of any kind, including an event, a physical object, an animal or a human being.

Individual Premise: $a$ 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 $G$.

An ontology, a framework that specifies and organizes classes of concepts that can be used to represent the important features of cases (Ashley, 2009, 8), can be used to represent classifications of concepts to support legal reasoning about claims and issues. It includes representation of actual concepts like ‘animal’, as well as legal concepts like ‘possession’. In order to see how argumentation-based theories of legal reasoning in artificial intelligence would model the reasoning in a typical common-law case, in addition to the scheme for argument from an established rule and the scheme for argument from verbal classification, we also need to take into account the working of the third scheme, called argument from precedent.

Most notably in common law countries, a ruling on a case is influenced by precedents. The most common type of argument from precedent used in legal reasoning applies to a current case, and a prior case that has already been decided where the ruling can be applied to the current case (Schauer, 1987). The argumentation scheme appropriate for this type of argument is the one for argument from precedent (Walton, Reed and Macagno, 2008, 72).

Previous Case Premise: the source case is a previously decided case.
Previous Ruling Premise: In the source case, rule $R$ was applied and produced finding $F$.
New Case Premise: the target case is a new case that has not yet been decided.
Similarity Premise: the target case is similar to the source case in relevant respects.
Conclusion: Rule $R$ should be applied to the target case and produce finding $F$.

This way of configuring argument from precedent makes it a species of argument from analogy. In the next section, we will see how argument from classification is an extension of argument from analogy typically used in many arguments from precedent.

The following example can be used to illustrate how forms of reasoning like argument from an established rule and argument from a verbal classification can be used to form a chain of reasoning in a legal case that has the claim at issue in the case as its ultimate conclusion to be proved. In this U.S. Supreme Court case (CSX Transportation, Inc. v. Alabama Department of Revenue et al. certiorari to the U.S. U.S. Court of Appeals for the eleventh circuit No. 09-520, decided February 22, 2011) CSX, claimed that the State of Alabama had discriminated against
them ([http://www.supremecourt.gov/opinions/10pdf/09-520.pdf](http://www.supremecourt.gov/opinions/10pdf/09-520.pdf)). The State taxes diesel fuel consumed by railroads but exempts interstate motor and water carriers. CSX claimed that this tax scheme discriminates against railroads in violation of the Railroad Revitalization and Regulatory Reform Act of 1976 which bars discriminatory taxation. The trial summary quoted below gives a concise account of the chain of reasoning used by the court to arrive at its decision.

The key question thus becomes whether a tax might be said to “discriminate” against a railroad under subsection (b)(4) where the State has granted exemptions from the tax to other entities (here, the railroad’s competitors). Because the statute does not define “discriminates,” the Court again looks to the term’s ordinary meaning, which is to fail to treat all persons equally when no reasonable distinction can be found between those favored and those not favored. To charge one group of taxpayers a 2% rate and another group a 4% rate, if the groups are the same in all relevant respects, is to discriminate against the latter. That discrimination continues if the favored group’s rate goes down to 0%, which is all an exemption is. To say that such a tax does not “discriminate” is to adopt a definition at odds with the word's natural meaning. This Court has repeatedly recognized that tax schemes with exemptions may be discriminatory. See, e.g., Davis v. Michigan Department of Treasury, 489 U. S. 803. And even Department of Revenue of Ore. v. ACF Industries, Inc., 510 U. S. 332, on which the Eleventh Circuit heavily relied in dismissing CSX's suit, made clear that tax exemptions “could be a variant of tax discrimination.” Id., at 343. In addition, the statute’s prohibition of discrimination applies regardless whether the favored entities are interstate or local. The distinctions drawn in the statute are not between interstate and local actors, as Alabama suggests, but between railroads and all other actors, whether interstate or local.

The central reasoning in this case can be visually represented as a tree structure with the ultimate conclusion at the top, with the relevant arguments used to support that conclusion represented in the argument diagram. The text boxes represent the statements that are the premises and conclusions of the arguments. The nodes represent arguments and the lines joining the nodes to text boxes represent inferences from premises to conclusions. In many instances, the conclusion of one argument becomes a premise in the next one, producing a chain of argumentation terminating in the root of the tree at the top.

We can see that in some instances an argument is represented as having one premise, while in other instances an argument has multiple premises. In some cases we have two or more separate arguments going to support the same conclusion. For example, the two arguments for argument from established rule just under the conclusion that attacks might be said to discriminate against a railroad under subsection etc. each independently support it. This type of structure is sometimes called a convergent argument. Where we have two or more premises that are combined together to support the same conclusion so that each premise needs the others, this configuration is called a linked argument. The argument from the rule of definition at the top is a case in point.

To keep the argument diagram in figure 1 as clear and concise as possible at this point, no implicit premises have been represented. For example, three arguments just under the main conclusion have implicit premises, but these premises are not represented on the diagram. Argumentation schemes representing typical forms of defeasible reasoning are placed near all of the argument nodes in the diagram except one. Not all instances of argumentation have a known argumentation scheme that represents the type of argument, and its form, that enable the inference transition from the premises to conclusion. All the argumentation schemes in figure 1 are explained later in the chapter (except one, called ‘argument from ordinary meaning’). Pro-
arguments, arguments supporting the conclusion, are indicated by a plus sign in the argument node. Contra arguments, arguments against a conclusion, are indicated by a minus sign in the argument node. This argument map was drawn using the Carneades Argumentation System, computational system that has an argument mapping tool specially designed to represent legal argumentation. How the system works will be briefly explained later in part four of the paper.

Figure 1: Chain of Argumentation in the CSX Case
Representing the reasoning used in this case presented in the quoted Supreme Court summary above offers a nice way of visually grasping how legal reasoning works by applying rules to cases and by a process of classifying key terms. Once we realize that this kind of reasoning is defeasible and that it is based on terms that are open-textured and very susceptible to argumentation by the opposed side, it no longer seems as simple or straightforward as it might have been when we call it “applying rules to cases”. Understanding how rules should be applied to cases takes us to the subject of reasoning from precedent cases.

Reasoning from a precedent depends on an underlying form of reasoning from analogy based on the similarity of the source case to the target case. On this model, rules are continually being modified as they are applied over and over again to a series of cases. By means of examining a number of examples of legal rulings that demonstrate how actual legal method in the common law systems work from examples that result in changes of legal rulings in successive trials, Levi (1968, 104) was led to the conclusion that “legal reasoning has a logic of its own”. These examples revealed a contrast between “logic and actual legal method” (104). According to Levi’s analyses of how legal decisions were arrived at in the extensive examples he provided, particular entities are classified as falling under general terms that occur in rules that are applied to cases and then modified when the new case is decided on in a different way. According to Levi (1968, 8), this process of legal reasoning has three stages. The first stage is the creation of a legal concept built up from cases. The second stage continues this process of reasoning by example by fixing the concept. The third stage is the breakdown of the concept. The example given by Levi (8-27) is the “inherently dangerous rule”. In commercial transactions where one party sells something to another party and the second party is injured by using the product, differences in liability turn around the issue of whether a commercial product can be classified as “inherently dangerous” or not. This category was gradually expanded through a series of cases where one product was judged to be similar enough to another product that had already been classified as inherently dangerous so that the second product could also be placed in the same category.

2. Case-based Reasoning from Analogy

The literature on argument from analogy in fields spanning logic, argumentation studies, computer science and law, is enormous. Many proposals have been put forward to represent argument from analogy as a form of reasoning or argumentation scheme, and there is no space to try to summarize them here. We can only refer the reader to the multi-disciplinary bibliography of Guarini et al. (2009). However, the use of argument from analogy in case-based reasoning (Ashley, 1988) is central. Instead, we concentrate on two particular proposals to represent the structure of this argumentation scheme that provides a useful contrast to focus the discussion.

The simplest argumentation scheme for argument from analogy can be represented by this first version from (Walton, Reed and Macagno, 2008, 315).

Similarity Premise: Generally, the source case is similar to the target case.

Base Premise: $A$ is true (false) in the source case.

Conclusion: $A$ is true (false) in the target case.

Let’s call this scheme the basic scheme for argument from analogy. The assumption behind the basic scheme for argument from analogy is that there exists a similarity between two cases where $A$ holds in the source case and can shift a weight of evidence to make it plausible that $A$ holds in both cases. This kind of argument is defeasible, and it can in some instances even be misleading.
and fallacious, as the traditions of informal fallacies warn us (Hamblin, 1970). It is an important kind of argument to study, because so much of our reasoning is based on it (Schauer, 2009). But how can similarity be modeled in such a way that we have evidence that is useful to determine whether and how the source case is similar to the target case? An example is helpful.

Barry Bonds hit a valuable home run ball into the stands in the case of Popov v Hayashi, in a trial concerning the issue of which one of two fans could claim ownership rights to the ball. The reasoning in the trial partly turned on some historical precedent cases that concerned the hunting and fishing of wild animals. The trial became a classic example for study on how case-based reasoning can be applied from similar precedent cases to an analogous case at issue (Wyner at al., 2007; Bench-Capon, 2009, 2010). The ball went into the upper portion of the webbing of a glove worn by a fan, Alex Popov, but as it entered his glove, he was thrown to the ground by a mob of fans trying to get the ball. While Popov was pinned to ground by the mob, a nearby fan, Patrick Hayashi, not part of the mob that had knocked Popov down, pocketed the loose ball. When the man making the videotape pointed the camera at Hayashi, he held the ball in the air for the others to see. Hayashi was not at fault for the assault on Popov. According to generally accepted rules of baseball, a fan has the right to keep the baseball he has caught in the stands. But such a catch only bestows this right when the fan has the ball in his hand or glove and the ball remains there after its momentum has ceased. If no one catches the baseball, any person in the stands may come to own it by picking it up. According to these accepted rules, it would appear that Hayashi had the right to ownership of the ball. However, Popov also claimed this right and took the case to court.

The contested issue in the trial that took place in the Superior Court of California City and County of San Francisco was about which party should properly be said to have possession of the ball, but the outcome could not be decided by simply applying the legal concept of possession (McCarthy, 2002, 5). Some comparable historical precedent cases were presented where there was pursuit of an animal that the pursuer failed to catch because somebody or something intervened, and the issue was whether the pursuer could claim possession of the animal. In the case of Pierson v. Post (3 Cai. R. 175; 1805 N.Y. LEXIS 311), Pierson was chasing a fox with hounds when Post captured and killed it, even though he was aware that it was being pursued. The court decided in favor of Post on the basis that mere pursuit did not give Pierson a right to the fox. In the case of Young v. Hitchens (6 Q.B.606 (1844)), Young was a fisherman who spread his net, but when it was almost closed, Hitchens went through the gap with a net and caught the fish. The court decided in favor of Hitchens. In Keeble v. Hickeringill, ((1707) 103 ER 1127), P owned a pond and made his living by shooting ducks lured onto it with decoys and selling them. D used guns to frighten the ducks away from the pond. This case was decided in favor of P. In Ghen v. Rich (8 F.159 D. Mass, 1881), Ghen harpooned a whale from his ship, but it was washed ashore found by another man who sold it to Rich. The generally accepted rule of whaling was that the party who finds the whale should report it and can then collect a fee. This case was decided in favor of Ghen.

In the end, after examining many arguments, Judge McCarthy (2002, 9) ruled that any award to one party would be unfair to the other, and that each had an equal and undivided interest in the ball. The historical precedent cases are nevertheless interesting in their own right as part of the evidence in the case, because they raise questions about what is meant by ‘similarity’ when a precedent case is seen to be analogous to a case at issue. In many respects these wild animal cases are not similar to the baseball case at all. As Gray (2002, 1) observed, “a baseball at the end of its arc of descent is not at all like a fox racing across the commons, acting under its own
volition, desperately attempting to evade death at the hands of its pursuers”. But there is a general similarity underlying the pattern of action in all these cases. In general, they are all about an agent trying to catch something to possess it, and about some kind of interference that prevented him from obtaining it, leading to a question of who has the right to possess it (Walton, 2010). The similarity can be visualized as an abstract sequence of actions and events that hangs together in a pattern shown in figure 2, where x is a variable for an object and y and z are variables for agents. The open arrows represent transitions from one action or event to another in a story scheme (Pennington and Hastie, 1963; Bex, 2009), while the closed arrows represent inferences drawn to a conclusion.

Figure 2: Basis of Similarity of the Animals Cases to the Popov Case

On this view, legal reasoning is a sequence of steps based on similarity between pairs of cases in which a rule applied to one case can also be applied to a second case that is taken to be similar to the first one. Essentially, the sequence of reasoning is based on argument from analogy.

Figure 3: Sequence of Case-based Similarity Reasoning from Analogy
But that is not the end of the sequence. There were two possibilities. The argument from analogy may be defeated when a significant difference between the two cases is found (Ashley, 2006). Such a difference arises because different facts are emphasized as important by a different judge. The other possibility is that the argument from analogy may be successfully applied to the second case, and this in turn may have two possible outcomes, shown in figure 3. One outcome is that the rule may fit the second case, and in this instance the same conclusion will be drawn in the second case as was drawn in the first case. The other is that the rule will be changed, by being qualified or otherwise modified, or it may even by being replaced by a different rule that replaces the earlier rule. When this outcome occurs, the new rule can be applied to a new case, the third case in the sequence, which starts the whole process over again, or establishes the new rule, and the new third case is applied to a fourth case on the basis of a similarity seen between the third and fourth cases.

Levi (1948, 3) sums up the process by not agreeing that it is a system of applying rules to facts, but rather by showing that it is a complex one in which “the rules are discovered in the process of determining similarity or difference”. This kind of reasoning is dynamic, because there is a continual feedback process in which the new cases may lead to rulings that are inconsistent with the rules held in the old cases, in which the terms used in the new cases may result in different classifications from those in the old cases.

This process cycles on and on indefinitely as the rules of law are refined, creating precedents by being applied to new cases, as shown in figure 4.

![Figure 4: Successive Refinement of Cases as a Continuing Sequence](image)

The sequence of reasoning shown in figure 4 is a process of successive refinement based on analogies between cases. The best model we have of this procedure of reasoning to conclusions is that of case-based reasoning, a technology used to solve a problem posed in a given case by drawing on similar cases retrieved from a database of past cases (Ashley, 2006). The solution to the problem posed in the given case is achieved by matching the given case against the retrieved cases by a process of analogy that selects similar cases. The HYPO system, produces point-counterpoint arguments in trade secrets law, and the CATO system teaches law students how to create case-based arguments. HYPO analyzes a given case by retrieving similar cases from its knowledge base, and makes a judgment concerning which cases are most “on point”. CATO has templates for argument moves, like argument from analogy, and rules that show how to attack a rule (Ashley and Rissland, 2003, p. 41). It can generate an argument for one side while also producing counter-arguments in support the other side. Case-based reasoning requires argumentation schemes, especially argument from analogy and argument from precedent (Ashley, 2009), combines these arguments into chains of argumentation modeled on the chain of reasoning shown in figure 4.
3. Reasoning and Argument

From a logical, as opposed to a psychological point of view, reasoning may be defined as a series of steps of inference in which some propositions are inferred from others (Walton, 1990, 404). Reasoning is sequential and best visualized abstractly as an argument diagram where propositions are contained in text boxes. These text boxes are joined to other text boxes with arrows representing inferences from some propositions to others. Although it is possible to have (as in multi-conclusion logic) premises that lead by inferences to two or more distinct conclusions, it simplifies our view of reasoning if we exclude this possibility. On this more restricted view, reasoning can have several starting points (premises) but the inference drawn from them always leads to a single conclusion. On this view, however, reasoning can be sequential. That is, some premises can lead to a particular conclusion, and this conclusion can then become a premise in a next step of inference to a different conclusion. Such a configuration is called chaining of reasoning in artificial intelligence. If we look at an argument this way, its structure can always be represented as a type of tree referred to as a tree with a single root proposition as the ultimate conclusion. This tree branches outwards to a series of connected inferences all leading away from the ultimate conclusion that is the root. An excellent example is the reasoning used in a Supreme Court case represented as an argument diagram using the Araucaria tool for argument visualization (figure 1). The reader can see that the diagram of the chain of reasoning as a tree structure with one proposition designated as the ultimate probandum represented as the root of the tree.

To help clarify this definition of reasoning it is helpful to draw a distinction between epistemic reasoning and practical reasoning. Epistemic reasoning is used to determine whether a proposition is true or false, or whether it is unknown to be either true or false, based on the knowledge of an agent. The simplest form of practical reasoning, called instrumental practical reasoning, has the following form (Walton, Reed and Macagno, 2008, 323). The first-person pronoun ‘I’ represents a rational agent that has goals, some (though possibly incomplete) knowledge of its circumstances, the capability of altering those circumstances, and the capability of perceiving the consequences of so acting.

Major Premise: I have a goal $G$.

Minor Premise: Carrying out this action $A$ is a means to realize $G$.

Conclusion: Therefore, I ought (practically speaking) to carry out this action $A$.

Practical reasoning can move forward, from a goal to an action, as part of agent-based deliberation, but it can also be used backwards by inference to the best explanation (see below) to reconstruct an agent’s internal mental states like motive or intent, based on an agent’s known actions and words.

Practical reasoning can be undercut by citing possible negative consequences of the proposed action. Such a form of attack is a species of reasoning in its own right (Walton, Reed and Macagno, 332).

Premise: If $A$ is brought about, then bad consequences will occur.

Conclusion: $A$ should not be brought about.

By its use of the word ‘bad’, this form of reasoning is seen to be based on values that the agent may be presumed to have and hence it is a species of value-based reasoning (Bench-Capon, 2003). However, arguments from positive or negative values can also operate as individual arguments in their own right ((Bench-Capon, 2003) independently of argument from consequences. The first argumentation scheme represents the argument from positive value.
Major Premise: If value $V$ is positive, it supports commitment to goal $G$.
Minor Premise: Value $V$ is positive as judged by agent $a$.
Conclusion: $V$ is a reason for $a$ to commit to goal $G$.
The negative counterpart is called argument from negative value.
Major Premise: If value $V$ is negative, it supports commitment to goal $G$.
Minor Premise: Value $V$ is negative as judged by agent $a$.
Conclusion: $V$ is a reason for $a$ to retract commitment to goal $G$.
Argument from values is combined with instrumental practical reasoning to yield the scheme for value-based practical reasoning. This scheme was first formulated in the following form by Atkinson and Bench-Capon (2007, 861).

Circumstances Premise: $S_1$ is the case in the current circumstances.
Action Premise: Performing $A$ in $S_1$ would bring about $S_2$.
Goal Premise: $G$ would be realized in $S_2$.
Value Premise: Achieving the goal $G$ would promote the value $V$.
Conclusion: Action $A$ should be performed.

The following critical questions match the scheme for value-based practical reasoning.

CQ1: Is $V$ a legitimate value?
CQ2: Is $G$ a worthy goal?
CQ3: Is action $A$ possible?
CQ4: Does there exist an action that would bring about $S_1$ more effectively than $A$?
CQ5: Does there exist an action that would realize the goal $G$ more effectively than $A$?
CQ6: Does there exist an action that would promote the value $V$ more effectively than $A$?
CQ7: Would performing $A$ in $S_1$ have side-effects which demote $V$ or some other value?

An example of value based practical reasoning (Atkinson, Bench-Capon and McBurney, 2006, 82) is: I may diet to lose weight, with the goal of not being overweight, to promote the value of health. In the value-based scheme the notion of a goal is separated into three elements: the state of affairs brought about by the action, the goal (the desired features in that state of affairs), and the value. The value is defined as the reason why those features are desirable. The structure is based on an Action-based Alternating Transition System (Wooldridge and van der Hoek, 2005) in which an agent performs an action by moving from a current state of affairs to a new one with many differences that may make the new state of affairs better with respect to some value of the agent.

Practical reasoning is used in a situation of uncertainty and incomplete knowledge where an agent has to make a decision in a given situation that is constantly changing, based on its goals and its knowledge of that situation. This assumption that there is new incoming information to the agent because the situation is constantly changing is called the open world assumption in artificial intelligence. The conclusion is whether a particular course of action should be taken or not. If not doing anything at all (inaction) needs to be represented as a possible course of action, because doing nothing at all can often have negative consequences and can affect the agent’s goals. Although the open world assumption is typical of practical reasoning of the kind that takes place in realistic decision-making, it is also possible in some instances to invoke what is called the closed world assumption. The closed world assumption rules that no further evidence will count as relevant because the knowledge already available can be regarded as exhaustive of all the relevant evidence for the conclusion.

In a common law criminal trial, the presumption of innocence is taken to shift the burden of proof onto the prosecution to prove its claim of guilt to the standard of beyond a reasonable
doubt. All the defense has to do is to cast doubt on the argumentation put forward by the prosecution. This asymmetrical management of the burden of proof in a trial is evocative of the argument from lack of evidence, often called the argument from ignorance in the literature on informal fallacies in logic. However, when used in this context, the following version of the argument is reasonable: it has not been proved that the defendant is guilty, therefore the defendant is innocent (not guilty). This kind of reasoning is reasonable, except for a complication in cases of Scottish jurisdiction, where the jury can return a verdict of not proven. The question of how burden of proof should be determined in different settings of argumentation is taken up in section 6.

Invoking the closed world assumption has been identified as a form of epistemic reasoning called argument from lack of evidence (Walton, Reed and Macagno, 2008, 327).

Major premise: If \( A \) were true, then \( A \) would be known to be true.

Minor Premise: It is not the case that \( A \) is known to be true.

Conclusion: \( A \) is not true.

This form of reasoning depends how far along the search for evidence has progressed in a given case, and may therefore be regarded as defeasible, unless the knowledge base can be closed on the grounds that all the available evidence has been collected and processed. This ground is called the standard of proof (see section 6). The following inference is an example of a typical instance of this kind of reasoning in history.

Minor Premise: There are no known instances of Romans being awarded medals for bravery in battle posthumously.

Major Premise: If there were instances of Romans being awarded medals for bravery in battle posthumously, we would know of them.

Conclusion: Therefore the Romans did not award medals for bravery in battle posthumously.

To support the minor premise, the following statements might be offered as evidence: we would see evidence on tombstones or in written records of battles. Sometimes reasoning from lack of evidence can be provisionally acceptable, depending on the standard of proof, even though it is based on negative evidence.

If the closed world assumption cannot properly be made, there is the possibility of new information that can affect the outcome of practical reasoning. It is especially important for adequate practical reasoning that a rational agent be open to new incoming information and be flexible in taking this information into account in modifying its goals and actions accordingly.

Another form of inference that is very important in legal reasoning is abductive reasoning, or inference to the best explanation (Pardo and Allen, 2008). According to Josephson and Josephson (1994, 14), abductive inference has the following form, showing its structure as inference to the best explanation. \( H \) is a hypothesis.

- \( D \) is a collection of data.
- \( H \) explains \( D \).
- No other hypothesis can explain \( D \) as well as \( H \) does.
- Therefore \( H \) is probably true.

An example quoted from (Wigmore, 1940, p. 420) shows how he analyzed cases of legal evidence as instances of inference to the best explanation.

The fact that \( a \) before a robbery had no money, but after had a large sum, is offered to indicate that he by robbery became possessed of the large sum of money. There are several other possible explanations - the receipt of a legacy, the payment of a debt, the
winning of a gambling game, and the like. Nevertheless, the desired explanation rises, among other explanations, to a fair degree of plausibility, and the evidence is received. The evidence put forward in this example has the form of an inference to the best explanation where the conclusion as arrived at by means of a choice among several competing explanations of given facts.

Another important form of reasoning in law is the drawing of an inference is based on perception (Pollock, 1995, 41).

Premise 1: Person $P$ has a $\phi$ image (an image of a perceptible property).
Premise 2: To have a $\phi$ image (an image of a perceptible property) is a *prima facie* reason to believe that the circumstances exemplify $\phi$.
Conclusion: $\phi$ is the case.

Pollock (1995, 41) offered the following argument as an example.

Minor Premise: This object looks red to me.
Major Premise: When an object looks red, then (normally, but subject to exceptions) it is red.
Conclusion: This object is red.

This argument is defeasible, as Pollock pointed out, since even objects that are not red can look red when illuminated by a red light. It is a species of defeasible reasoning that can give a reason to accept its conclusion, provided there is no reason to think that the situation is exceptional.

The most important forms of legal reasoning in law are defeasible (Hart, 1949). Other good examples are instances of drawing inferences from sources, like reasoning from witness testimony and expert opinion. Such forms of reasoning are not well modeled by a deductive logic based on the major premise that what an expert says is always true. Fitting reasoning from expert opinion testimony a deductive model would render it into a fallacious form of reasoning by making it intolerably rigid. Instead, we need to look to defeasible reasoning.

4. Reasoning by Drawing Inferences from Sources

Drawing an inference from perception clearly represents a kind of reasoning we utilize all the time, not only in law but also in scientific reasoning and in everyday conversational reasoning. As skeptics have often noted, this kind of reasoning is defeasible. Unfortunately, however, in many situations where we have to draw a conclusion on what to do or what to accept as a hypothesis, the reasoner himself has no direct access to data through perception. In such cases, we have to rely on information derived from sources. Source-based reasoning is vitally important in law, because many of the supposed facts happened in the past. One of the most important forms of source-based reasoning and law is inference from witness testimony. The argumentation scheme for this form of reasoning is given in (Walton, 2008, 60). It has three premises.

Position to Know Premise: Witness $W$ is in a position to know whether $A$ is true or not.
Truth Telling Premise: Witness $W$ is telling the truth (as $W$ knows it).
Statement Premise: Witness $W$ states that $A$ is true (false).
Conclusion: Therefore (defeasibly) $A$ is true (false).

In argument from witness testimony, two key premises are the position to know premise and the truth telling premise. It is assumed that the witness is basing what she says on her genuine knowledge of some real situation or true set of facts. Moreover, it is assumed that she is telling the truth about those facts, as she saw or knows what she witnessed. These assumptions pose some constraints on witness testimony as a form of argument. It needs to be assumed that the
account the witness has presented is internally consistent, and is consistent with known facts of the case that can be verified by independent objective evidence. These matters can be tested by using the following critical questions (Walton, 2008, 61) matching the scheme for argument from witness testimony.

- Internal Consistency Question: Is what the witness said internally consistent?
- Factual Consistency Question: Is what the witness said consistent with the known facts of the case (based on evidence apart from what the witness testified to)?
- Consistency with Other Witnesses Question: Is what the witness said consistent with what other witnesses have (independently) testified to?
- Trustworthiness Question: Is the witness personally reliable as a source?
- Plausibility Question: How plausible is the statement A asserted by the witness?
- Bias Question: Is there a bias that can be attributed to the account given by the witness?

If the witness was really in a position to know the facts of a case and is giving an honest and accurate report of what she saw or heard, this should produce an account that is internally inconsistent. Or if it does not appear to be consistent in some points, the apparent inconsistency should be able to be explained or resolved. But consistency can only be tested by probing into the account given by the witness, and seeing if her story “stands up” under questioning during examination. This procedure is analyzed in the next section.

Another form of argument that is important in legal reasoning is that of argument from expert opinion. Epistemic reasoning to a conclusion based on expert opinion testimony as an admissible form of evidence requires that the source be qualifiable as an expert. For example, ballistics experts and DNA experts are often used to give expert testimony as evidence in trials, but they must qualify as experts. The most basic version of the form of reasoning from expert opinion is modified from the one in (Walton, Reed and Macagno, 2008, 310) as follows.

- Major Premise: Source E is an expert in field F.
- Minor Premise: E asserts that proposition A is true (false).
- Second Minor Premise: A is within F.
- Conclusion: A is true (false).

It is not helpful to treat this form of reasoning as deductive, for that would amount to taking an expert as an infallible source of knowledge. Taking that approach makes argumentation susceptible to many serious problems known to be associated with the fallacious misuse of argument from expert opinion. According to the contrasting approach of (Walton, 1997, 223) an argument from expert opinion should be evaluated by the asking of six basic critical questions.

- Expertise Question: How credible is E as an expert source?
- Field Question: Is E an expert in the field F that A is in?
- Opinion Question: What did E assert that implies A?
- Trustworthiness Question: Is E personally reliable as a source?
- Consistency Question: Is A consistent with what other experts assert?
- Backup Evidence Question: Is E’s assertion based on evidence?

According to (Walton, 1997), if a respondent asks any one of the six critical questions, the original argument defaults until the question has been answered adequately.

A problem with using critical questions to evaluate cases where expert opinion is used as a source of evidence is that we can no longer use an argument diagram to summarize, analyze or evaluate the basic evidence in a case and display its structure as a sequence of reasoning. The reason is that everything that appears in the text box on a standard argument diagram needs to be a statement, a proposition that is either true or false. It is harder to analyze the structure of
questions, even though they are certainly very important as devices in both everyday and legal argumentation, for example in examining a witness. Using critical questions definitely takes us outside the realm of reasoning to the realm of argument, where claims are made and subjected to doubt by the asking of critical questions by an opponent.

We can see the problem more explicitly if we ask what happens when a critic asks a critical question. If the critic asks the opinion question, in other words if he asks the arguer who has appealed to argument from expert opinion to quote the specific statement that the expert made that supposedly implies $A$, then the arguer certainly has to respond to this reasonable question by presenting the critic with a specific proposition, for example by quoting exactly what the experts said. If the arguer fails to carry out this reasonable kind of request, this argument from expert opinion will surely fail to be persuasive. However, suppose the critic asks the trustworthiness question: is $E$ personally reliable as a source? It could be perfectly reasonable for the arguer to shift the burden of disproof back to the questioner by replying, “of course she is personally reliable, for after all she is an expert, and if you wish to make any allegation to the effect that she has not personally reliable, you had better prove that.” This kind of reply would certainly be sufficient as an adequate answer to the question. In other words, there are two kinds of critical questions. When the first kind of critical question is asked, any failure to answer inappropriately will defeat the argument. When the second kind of critical question is asked, the burden shifts to the arguer to the questioner to support the critical question with further argument. Because of these crucial differences between the critical questions, it seems to represent them in any straightforward way as statements that are additional assumptions of the argument.

Fortunately, however, there is a way that we can represent critical questions on an argument diagram by treating them as additional premises that need to be added to the given premises in argumentation scheme (Walton and Gordon, 2005). Artificial intelligence has found a way to do this by using the Carneades software (Gordon, 2010). Carneades is a mathematical and computational model that defines mathematical properties of arguments that are used to identify, analyze and visualize real arguments. By applying argumentation schemes, Carneades analyzes and evaluates the acceptability of arguments, based on proof standards, for example preponderance of the evidence.

![Figure 5: Argument from Expert Opinion with Undercutter in a Carneades Map](image-url)
Carneades takes the approach that the way critical questions are modeled depends on the individual argumentation scheme, by distinguishing three kinds of premises. Ordinary premises are just the regular premises of an argumentation scheme that are explicitly given in the scheme itself. But there are two additional kinds of premises not stated in the scheme. Assumptions are to be acceptable unless called into question. Exceptions are modeled as premises that are not assumed to be acceptable and that can defeat an argument as it proceeds. Ordinary premises of an argument, like assumptions, are assumed to be acceptable, but they must be supported by further arguments in order to be judged acceptable.

In figure 5 the conclusion of the argument from expert opinion is represented by the text box at the far left stating that \( A \) is true. The argument from expert opinion is represented in the node with a plus sign in front of its name, indicating it is a pro-argument supporting the conclusion that \( A \) is true. In the list of premises on the right of the node, the first four are the ordinary premises of the scheme for argument from expert opinion. Hence they are classified as being in assumptions, statements that are assumed to hold, but are subject to critical questioning. Since there are no arguments against them, or critical questions directed to them, they are shown as acceptable in figure 5 by darkening the text boxes in which they appear. The next two premises are also classified as assumptions. Asking a critical question challenging either one of these for assumptions will shift the burden of proof onto the proponent of the argument from expert opinion, and temporarily defeat it until the proponent replies to the question appropriately. Since they have not been questioned or attacked either, they are also shown as accepted. The two critical questions at the bottom, the trustworthy question and the ‘consistency with other what experts say’ question, are represented as exceptions. These two critical questions are shown on the diagram as undercutter, because they are displayed as contra arguments, indicated by the minus signs in their nodes. An undercutter is an argument that attacks an argument node rather than attacking a premise or conclusion (a proposition).

The ‘consistency with other what experts say’ question is an undercutter with a premise displayed in white text box indicating that it is not accepted. Notice however that the other one of these premises, the trustworthiness premise, has an argument from bias supporting the statement that the expert is not trustworthy. Since this undercutter has been backed up by evidence to support it, in the form of the argument from bias, it successfully defeats the argument from expert opinion.

![Figure 6: Counterattack to the Undercutter in an Argument from Expert Opinion](image-url)
Hence despite the fact that the other four premises above it are assumed to hold, the argument from expert opinion fails. Notice however that one of the premises of the argument supporting the claim that $E$ is biased is attacked by a counterargument stating that expert witnesses are normally paid to testify. In other words, the argument is that since expert witnesses are normally paid to testify, if a particular expert is paid to testify, that should not be taken as evidence that he is biased. However, the way they argumentation is represented in figure 5 to proposition that expert witnesses are normally paid to testify is not accepted, nor is it supported by a further arguments.

But what would happen if the proposition that expert witnesses are normally paid testify were to be accepted? This new evidential situation is shown in figure 6. Notice at the top right of figure 6 a contra argument based on the premise that expert witnesses are normally paid to testify has been used to attack one of the premises of the argument from bias. On the basis of this attack, one of the premises supporting the conclusion that $E$ is biased is no longer accepted. Hence the argument from bias is defeated by this premise attack, and the topmost undercutter now fails to defeat the argument from expert opinion. Since there is no supporting evidence behind the other undercutter displayed in the text box at the bottom of figure 6, the argument from expert opinion is restored. In this situation, Carneades will automatically display the ultimate conclusion that is true as ‘accepted’, once the user has input the information that all the other premises of the argument from expert opinion are assumed to hold, as shown in figure 6. So we can see that Carneades is a dynamic system that takes into account new arguments brought forward from its knowledge base, so that in some instances an argument that was formally used to successfully refute an argument can be defeated by a new argument.

We have shown how Carneades incorporates defeasible logic and builds on it to provide a computational tool that not only enables us to do argument mapping, but to represent the critical questions matching defeasible argumentation scheme on an argument map, and to track new relevant evidence coming in from its knowledge base.

5. Defeasible Logic

Defeasible logic is a logical system (Nute, 1994) that models reasoning used to derive provisional conclusions from partial and sometimes conflicting information. Using this kind of reasoning, a conclusion can be tentatively accepted, subject to new evidence that may come to be known at some point in the future of an investigation. This new evidence may require the retraction of the conclusion that was formerly accepted, based on the evidence that was available at that earlier point. The use of this kind of defeasible reasoning is highly appropriate during an investigation or sequence of argumentation where the inflow of new evidence may be closed off, even though it may later be reopened, for example in an appeal. Once the investigation has been closed off, the conclusion of the reasoning, can be accepted as final, for the purposes of the investigation. But before that point, where there is argumentation on both sides, and all the arguments are not in, the reasoning needs to be regarded as defeasible.

The basic units of defeasible logic are called facts and rules. Facts are statements that are accepted as true within the confines of a discussion. Statements, also called propositions, are denoted by letters, $A$, $B$, $C$, …, using subscripts if necessary. There are two kinds of rules in defeasible logic, called strict rules and defeasible rules. Strict rules are absolutely universal in the sense that they do not admit exceptions. An example of a strict rule would be the universal
generalization ‘All penguins are birds’. In defeasible logic, a strict rule has the form of a material conditional with a conjunctive antecedent of the following form: \( A_1, A_2, A_n \rightarrow B \). In this kind of conditional, it is not possible for all the \( A_i \) to be true and the \( B \) false. Defeasible rules are rules that are subject to exceptions, and that may fail if an exception is shown to exist in a given case.

An example of a defeasible rule would be the statement ‘Birds fly’, meaning that birds generally fly or that birds normally fly, but not implying that all birds fly without any exception being allowed. A defeasible rule has the form \( A_1, A_2, A_n \Rightarrow B \), where each of the \( A_i \) is called a prerequisite. The set of all the \( A_i \) taken together is called the antecedent, and the statement \( B \) is called the consequent. For example, suppose that Tweety is a bird, but we also know that he is a penguin, and that we know what that penguins cannot fly. In light of our knowledge of this exception, the conclusion that Tweety flies cannot be inferred and has to be retracted. The rule still holds, but the inference itself fails to support the conclusion any longer. Defeasible logic is the best way to represent the structure of reasoning of argumentation schemes of the kind most commonly used in law, for as shown above, this type of reasoning is defeasible.

It is a problem that the forms of reasoning that we are familiar with from deductive logic, and from the kind of inductive logical reasoning used in the Bayesian rules do not appear to fit argumentation schemes of the defeasible kind illustrated above. However, Verheij (2001, 232) showed that these defeasible argumentation schemes fit a form of argument he called *modus non excipiens*, which has the following form.

As a rule, if \( P \) then \( Q \)
\( P \)

It is not the case that there is an exception to the rule that if \( P \) then \( Q \)
Therefore \( Q \)

Verheij showed how this form of argument can be used for evaluating defeasible inferences like the Tweety argument: if Tweety is a bird, Tweety flies; Tweety is a bird; therefore Tweety flies. This form of argument was called defeasible *modus ponens* (DMP) by Walton (2002). A version of an example from (Copi and Cohen, 1998, 363) can be used to illustrate DMP: if he has a very good defense lawyer, he will be acquitted; Bob has a very good defense lawyer; therefore he will (likely) be acquitted. This argument is clearly defeasible, for even though Bob has a good lawyer, he may not be acquitted.

Using a concept from defeasible logic called defeasible implication, or the defeasible conditional, represent by the symbol \( \Rightarrow \), we can represent DMP is having the following form.

Major Premise: \( A \Rightarrow B \)
Minor Premise: \( A \)
Conclusion: \( B \)

The first premise is the conditional, ‘If \( A \) is true then generally, but subject to exceptions, \( B \) is true’. In some instances the argumentation schemes above, for example the argument from negative evidence, explicitly has the DMP form. In other instances, the scheme for argument from expert opinion for example, the scheme can be put into the DMP form by adding an implicit premise as an additional assumption.

To see how this works using an example, let’s consider the following expanded version of the argument from expert opinion scheme.

Major Premise: Source \( E \) is an expert in subject domain \( S \) containing proposition \( A \).
Minor Premise: \( E \) asserts that proposition \( A \) (in domain \( S \)) is true (false).
Conditional Premise: If source \( E \) is an expert in a subject domain \( S \) containing proposition \( A \), and \( E \) asserts that proposition \( A \) is true (false), then \( A \) may plausibly be taken to be true
Conclusion: $A$ may plausibly be taken to be true (false).

If you look at this version of the scheme, you can see that the argument from expert opinion has a defeasible *modus ponens* structure as an inference.

Major Premise: $(E$ is an expert & $E$ says that $A) \Rightarrow A$

Minor premise: $E$ is an expert & $E$ says that $A$

Conclusion: $A$

This form of argument is not exactly the same as DMP because the conditional in the major premise has a conjunctive antecedent. The scheme has this form: $(A \& B) \Rightarrow C, A \& B$, therefore $C$. Nevertheless, it is a substitution instance of the DMP form. It is fair to say that in its general outline it has the structure of the DMP form of inference.

The analysis so far, however, does not take into account the critical questions for the argument from expert opinion. There was a suggestion made by (Reed and Walton, 2003, 202) that the conditional premise could be expanded to take the critical questions into account in a still more fully expanded version of the scheme. This proposal is now easily carried out using the Carneades system of treating the critical questions as additional assumptions or exceptions in the scheme. This form of the argument can now be seen as fitting DMP.

6. Reasoning, Argument and Proof

Reasoning is included in argument, but argument is a wider notion. Argument is reasoning used to try to resolve some central issue that is unsettled (Prakken and Sartor, 2006). As stated above, in reasoning there is always a set of propositions called start points (premises) and a single endpoint (conclusion). In an argument, the conclusion is always the claim made by one party that is doubted, or is open to doubt by the other party. The other party may be a single person or an audience composed of more than one person, for example a jury. In argument, the conclusion is always unsettled, or open to doubt. Indeed, that is the whole point of using an argument. If there is no doubt about a proposition, and everybody accepts it as true, there is no reason for arguing either for or against it. Thus the speech act of putting forward an argument is different from the speech act of putting forward an explanation. An explanation is only appropriate if the proposition to be explained is taken as an accepted fact by all parties. An argument is only appropriate if the proposition at issue is not taken as an accepted fact by all parties, so that there is some doubt about whether it is true or not. The definition of the notion of an argument put forward here is dialectical, implying that an argument is only appropriate in a setting where two or more parties take part in trying to use reasoning to examine and evaluate the evidence on both sides of a disputed issue. The term ‘argumentation’ is appropriately used here, because an argument, defined in this way, always needs to be evaluated within a procedural setting. There needs to be an opening stage, in which the ultimate issue needs to be specified, an argumentation stage where the arguments on both sides are put forward so that they can be critically questioned by the opposing side, and the closing stage where it can be determined which side had the stronger argument.

One of the best examples of argumentation that can be given is a common law trial in which one side has made a claim that the other side disputes. The claim made by the first part is the ultimate probandum, the ultimate conclusion to be proved, while the other party has the job of casting doubt on the first party’s argument. In this setting, there are three parties involved, the two primary parties and a third-party trier, who may be a judge or jury. Procedural rules
determine what sort of evidence is admissible, and the two primary parties are supposed to use this evidence to try to prove their own contentions and cast doubt on the contentions of the other side. The trier makes a decision at the closing stage by examining the arguments on both sides and determining whether one side or the other successfully carried out its central task. The overall framework of a common law trial is that of a persuasion dialogue, because the party who has made the initial claim that defines the issue to be settled has a burden of persuasion. It has the burden to prove its claim by sufficient evidence or it loses by default and the other party wins. This burden is often called the presumption of innocence in criminal trials.

Although persuasion dialogue is a very important type of dialogue, so much so that argumentation is often mainly associated with it, there are other types of dialogue that it is important from a legal reasoning point of view. Six types were distinguished in (Walton and Krabbe 1995, 66), and a seventh type was also later recognized. Each type has a communal goal that needs to be distinguished from the individual goals of the participants. The defining characteristics of each type are shown in figure 1.

<table>
<thead>
<tr>
<th>Dialogue Type</th>
<th>Initial Situation</th>
<th>Participant’s Goal</th>
<th>Communal Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persuasion</td>
<td>Conflict of Opinions</td>
<td>Persuade Other Party</td>
<td>Resolve Issue</td>
</tr>
<tr>
<td>Inquiry</td>
<td>Need to Have Proof</td>
<td>Verify Evidence</td>
<td>Prove Hypothesis</td>
</tr>
<tr>
<td>Discovery</td>
<td>Need an Explanation</td>
<td>Find a Hypothesis</td>
<td>Support Hypothesis</td>
</tr>
<tr>
<td>Negotiation</td>
<td>Conflict of Interests</td>
<td>Get What You Want</td>
<td>Settle Hypothesis</td>
</tr>
<tr>
<td>Information</td>
<td>Need Information</td>
<td>Acquire Information</td>
<td>Exchange Information</td>
</tr>
<tr>
<td>Deliberation</td>
<td>Practical Choice</td>
<td>Fit Goals and Actions</td>
<td>Decide What to Do</td>
</tr>
<tr>
<td>Eristic</td>
<td>Personal Conflict</td>
<td>Hit Out at Opponent</td>
<td>Reveal Deep Conflict</td>
</tr>
</tbody>
</table>

Table 1: Seven Basic Types of Dialogue

Each type of dialogue has an opening stage, an argumentation stage and a closing stage. A dialogue is formally defined as an ordered 3-tuple \( \{O, A, C\} \) where \( O \) is the opening stage, \( A \) is the argumentation stage, and \( C \) is the closing stage (Gordon & Walton, 2009, 5). Procedural rules define what types of moves are allowed by the parties during the argumentation stage (Walton & Krabbe, 1995). At the opening stage, the participants agree to take part in some type of dialogue that has an identified collective goal. The initial situation is framed at the opening stage, and the dialogue moves through the argumentation stage toward the closing stage. This way of abstractly modeling argumentation in a dialogue setting is normative, meaning that it prescribes how the dialogue should ideally go if the participants aim to use reasoning to resolve the issue that was framed at the opening stage. In any real case, the actual order of events may be quite different.

In these dialogue systems, the simplest cases are those with only two participants. To test out the systems, Lodder (1999, p. 99) considered a short sample dialogue of legal argumentation arising out of an actual case. In this case, a gang member named Tyrell was searched during a football game, and he was found to be in possession of illegal drugs. The issue was whether this
evidence had been obtained illegally. The two participants in the dialogue are called Bert and Ernie, but any names could be chosen, like Proponent and Respondent, or Black and White.

Bert: It was not allowed to search Tyrell.
Ernie: Why do you think so?
Bert: Only if someone is a suspect may he be searched, and Tyrell was not a suspect.
Ernie: I agree, but Tyrell was on probation, and had to allow a search at any time.
Bert: You are right, a search was allowed.

What is especially interesting about the argumentation in this dialogue is that it is based on defeasible reasoning, based on generally accepted legal rules that are subject to exceptions. Two of these general rules can be identified as follows.

Search Rule: Someone may be searched only if he is a suspect.

Probation Rule: Someone who is on probation can be searched at any time.

The reason behind the second rule is that one of the conditions of probation is to allow a search at any time. Turning to the dialogue, the line of argumentation can be followed along, based on how these defeasible rules are applied. First, Bert made the claim that it was not allowed to search Tyrell. This assertion can be taken to mean that Bert has advocated a viewpoint, to use the language of the critical discussion. In other words, he has made a statement and committed himself to the truth or acceptability of it. In the critical discussion model, it follows that Bert is obliged to defend his claim, if challenged, or give it up, if the other party can give a convincing argument against it. Ernie then questions Bert’s claim, at the next move in the dialogue. Bert then fulfills his obligation by presenting an argument. His argument cites the claimed fact that Tyrell was not a suspect, along with the search rule as an additional premise. The two premises function together as an argument to support argument against Ernie’s prior argument. Also, it should be noted that the search rule is a defeasible rule that is subject to exceptions. Thus Bert’s argument, although it appears to be reasonable as matters stand, could be defeated by new evidence that might come into the dialogue. And in fact, that is what happens in the dialogue, when Ernie cites the presumed fact that Tyrell was on probation, and uses it along with the probation rule to put forward a new defeasible argument that defeats Bert's prior argument.

Information-seeking dialogue is, at first, hard to grasp as a framework of legal argumentation. The most familiar framework is that of persuasion dialogue, which is highly adversarial, in that its basic structure is based on opposed arguments. Prakken (2006) has investigated a formal framework for the study of dialogue games for argumentation in which each dialogue move either attacks or surrenders to some earlier move of the other participant. This framework assumes an explicit reply structure on dialogues and imposes strict protocols on turn taking and relevance. However, Prakken has also explored less rigorous and more permissive formal dialogues in which these strong conditions are relaxed. In these more permissive types of dialogue, alternative replies to the same turn are allowed, and some dialogues do not have to adhere to the rule that each move must have a bearing on the outcome of the dialogue. Prakken (2006, 28) presented the following example dialogue.

Witness: Suspect was at home with me that day.
Prosecutor: Are you a student?
Witness: Yes.
Prosecutor: Was that day during summer holiday?
Witness: Yes.
Prosecutor: Aren’t all students away during summer holiday?
Prakken cites this example as a case where the cross-examination of a witness has the goal of revealing an inconsistency in the testimony. He offered the example as a typical case in which a line of questioning does not indicate from the start where it is aiming. But clearly it is as species of information-seeking dialogue. It can also be identified as falling under the category of examination dialogue, a subspecies of information seeking dialogue. It should probably be seen as taking place at the beginning stage of the line of questioning, in which the prosecutor is asking questions of a kind that attempt to pin down the commitments of the witness in such a way that they can be subsequently be critically examined. One such strategy of cross-examination that the prosecutor may have in mind is that of later trapping the witness into committing himself to an inconsistency, or to some proposition that would appear to be implausible to the judge or jury in the trial. On this model even though the dialogue is a fragmentary one, and very little context is given, it can be straightforwardly categorized as an instance of a kind of examination dialogue that falls under the information-seeking category. Seen from a viewpoint of persuasion dialogue, it may appear to be aimless, but seen from a viewpoint of examination dialogue, it can be analyzed as part of a dialogue that has a goal.

So far there has been a lot of discussion about both reasoning and argument, but now we also need to consider the concept of proof. A proof may be defined as an argument in which the premises furnish sufficient evidence to reasonably accept the conclusion. A burden of proof is a requirement set on one side or the other to meet a standard of proof in order for the argument of that side to be judged successful as a proof. The problem in legal reasoning, and indeed in all kinds of reasoning generally, is that it is rarely if ever possible to be able to prove a conclusion beyond all doubt. Hence the question of when a burden of proof is met by a sequence of argumentation in a given case depends on the proof standard that is required for a successful argument in that case. What proof standard is required depends on the type of dialogue. In inquiry dialogue, for example an investigation into the cause of an air disaster, has a very high standard of proof. In another dialogue setting, the standard may not need to be set as high. Proof standards need to be set at the opening stage of a dialogue.

According to the scintilla of evidence standard, an argument is taken to be a proof even if there is only a small amount of evidence supporting it (Gordon and Walton, 2009). The preponderance of evidence proof standard is met by an argument that is stronger than the opposed argument in the case, even if it is only slightly stronger. The clear and convincing evidence standard is higher than that of the preponderance standard, but not as high as the highest standard, called proof beyond reasonable doubt. The beyond reasonable doubt standard is the strongest one, and it is applicable in criminal cases. The beyond reasonable doubt standard is often equated with the presumption of innocence in criminal cases.

Burden of proof is a slippery and vague notion in law, and so far it has resisted any precise definition that has been unanimously accepted in law. However, recent work in artificial intelligence has constructed logical models based on defeasible logic that are helpful in clarifying how the notion of burden of proof works in legal argumentation by distinguishing different kinds of burden of proof that can appear at different stages in a dialogue (Prakken and Sartor, 2003). At the opening stage, when a person makes a claim at the first point in the sequence described above, he has a right to a legal remedy if he can bring forward facts that are sufficient to prove that he is entitled to some remedy. This is called the burden of claiming. The second type of onus is the burden of questioning. If one party makes an allegation by claiming
that some proposition is true during the process of the argumentation, and the other party fails to present a counterargument, or even to deny the claim, then that claim is taken to be implicitly conceded. This type of burden of proof is called the burden of questioning because it puts an obligation on the other party to question or contest a claim made by the other side, by asking the other side to produce arguments to support its claim. The third burden is called the burden of production or the burden of producing evidence. It is the burden to respond to a questioning of one’s claim by producing evidence to support it.

The fourth type of burden of proof is called the burden of persuasion in law. It is set by law at the opening stage of the trial, and determines which side has won or lost the case at the end of the trial once all the arguments have been examined. The burden of persuasion works differently in a civil proceeding than in a criminal one. In a civil proceeding, the plaintiff has the burden of persuasion for all the claims he has made as factual, while the defendant has the burden for any exceptions that he has pleaded. In criminal law the prosecution has the burden of persuasion for all facts of the case. These include not only the elements of the alleged crime, but also the burden of disproving defenses. For example, let's say that in a murder case in a particular jurisdiction, the prosecution has to prove that there was a killing, and that it was done with malice aforethought. If the defendant pleads self-defense, the prosecution has to prove that there was no self-defense.

The fifth type of burden is called the tactical burden of proof. It applies during the argumentation stage of the trial, when a lawyer pleading a case has to make strategic decisions on whether it is better to present an argument or not. This is a hypothetical assessment made only by the advocates on the two sides, and it can shift back and forth during a sequence of argumentation.

7. Conclusions

Some important general theoretical questions for argumentation theory underlie this chapter. Although it is generally appropriate to call the inferential structures studied in the chapter argumentation schemes, in many instances they could equally appropriately be called reasoning schemes. Discussion of this question in the chapter has led to another high-level question for argumentation theory: what is the difference between reasoning and argument? It appears that at least in some instances, argumentation schemes apply to cases as forms of inference used to generate conclusions by inference from a set of assumptions. In such cases, the conclusion may be drawn by the inference of a solitary agent and may not be disputed or doubted by a second party. In such cases, it may seem appropriate to better describe the argumentation scheme by calling it a reasoning scheme. So why are they called argumentation schemes at all, if the process of generating conclusions by inference would seem to be appropriately described by using the term ‘reasoning’? The answer given in this paper is that they are forms of reasoning, and as such they can be used to identify instances of known kinds of reasoning, a useful task, but there is also an important reason why it is more generally appropriate to call them argumentation schemes. The reason is that the arguments fitting them are evaluated using sets of critical questions matching a particular scheme. This is a process in which one party, the proponent, puts forward an argument, another party, the respondent, ask critical questions in a dialogue format. In the simplest case, where two parties are involved, one of them is casting doubt on the other’s argument. Here the use of the term ‘argument’ is highly appropriate, because for there to be an argument there has to be a claim that is unsettled.
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References


