

eGanges epistemology and case reasoning

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Abstract

Legal expertise uses eight kinds of epistemology that determine argumentation and are inter-related. Two of the major kinds are rule epistemology and case epistemology. This paper focuses on the relationship between these two legal epistemologies, and shows that it is not appropriate to design case reasoners in isolation of the other seven kinds of expert epistemology, especially rule epistemology. The difficulties that arise in isolated development are likely to make the case reasoner epistemologically inadequate; incorporation of rule epistemology into the design of a case reasoner is more likely to produce epistemological soundness. The design of the smart shell, eGanges, and some of its legal applications, are used to illustrate how rule epistemology and case epistemology are integrally related. The concept of equity epistemology is also introduced to distinguish two categories of case epistemology known to legal expertise.

Keywords: computational case epistemology, computational rule epistemology, epistemological adequacy, equity epistemology, interactive visualisation.

Introduction

In the legal domain, a case reasoner cannot be epistemologically adequate if it does not make provision for the matters of rule argumentation that concern case reasoning. These matters can be identified by comparing case epistemology and rule epistemology in the common framework of the eGanges (electronic Glossed adversarial nested graphical expert system) shell epistemology. The comparison reveals that a case reasoner without rule epistemology lacks the systems analysis and design that is necessary for full compliance with legal epistemology.

Legal Epistemologies

Two Greek words make up the word epistemology: *episteme*, meaning knowledge, and *logos* meaning plan. Legal epistemology is the plan of legal knowledge. There are eight kinds of epistemologies in the domain of legal

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expertise:

1. Profession and authority – how power to make and administer law is distributed;
2. Rules of law – how an expert opinion or judgment is determined;
3. Cases – how precedent cases are given effect in the formulation of expert opinion or judgment;
4. Evidence – how findings of fact are determined (See Wigmore, 1913, 1931 and 1937.);
5. Litigation – how court orders are obtained;
6. Commercial practice – how benefits of law are obtained;
7. Legal strategies – how gains are maximized and losses are minimized through law;
8. Justice – how justice is achieved in the legal system.

The way in which these eight epistemologies are interpreted and applied may vary from expert to expert. This paper sets out one expert version as a matter of expert knowledge acquisition. There is no attempt to validate this version by reference to other expert versions. It is not within the scope of this paper to do so; such an exercise would be far too copious, and the value of it can at best be tenuous. Both good and bad legal epistemologists are sometimes successful in legal practice. However, the version of expert epistemology in this paper is described in terms of logic and in terms of a program epistemology. It can be critically evaluated or adjusted in this way.

The eight epistemologies are inter-related and their inter-relationships must be accounted for to achieve epistemological soundness in a legal expert system. Epistemological adequacy is a requirement for artificial intelligence (McCarthy and Hayes, 1969; see also Reichgelt 1991, pp10-11, for criteria of epistemological adequacy). Criteria for epistemological adequacy of case reasoners are partially derived from rule epistemology.

eGanges epistemology

In a legal expert system, computational epistemology provides the program plan for rule epistemology and case epistemology; the other six legal epistemologies may also be built into the program (Gray,2004). This is illustrated through the shell epistemology of eGanges which has three major features:

1. Knowledge structures
2. Knowledge processing structures
3. Functionality

Knowledge structures form the basis for knowledge processing structures; together knowledge structures and knowledge processing structures form the basis for functionality. Case epistemology and rule epistemology can

be compared by reference to these program structures to show that case epistemology provides a collective of case pathways that require rule system analysis and design for epistemological soundness.

Case epistemology

The knowledge structures in case epistemology are the semantic units that are the facts and material facts of a case. Facts are required in order to establish, directly or indirectly, the material facts of a case. Certain existences must be established by evidence in order to prove a given material fact. Evidence is a term of law and the law of evidence is an extensive area of law; the rules of evidence are a legal epistemology which largely uses empirical standards. Material facts are the antecedents which lead to the final consequent or Final result of the case; a pathway of antecedents is established in each case.

Legal ontologies of substantive law may distinguish what exists that can be established by evidence as facts, from what is a socio-legal construct or legal concept that is a material fact. Ontological arrangements of facts may constitute material facts. Sometimes facts are adopted in law as material facts; as such they are adopted as socio-legal constructs. In a sense, socio-legal constructs exist; they are acted on as if they exist. They may be as real as the human mind itself. In the legal domain they are treated as such, be they verified ontologically or not. A legal system is itself a socio-legal construct. However, socio-legal constructs need not exist or be acted on; they are a matter of choice and informed choice is a process that concerns epistemology. Law determines when a socio-legal construct exists or does not exist, and what the law enforcement powers will choose to do about it (cf. Vaihinger, 1911, 1965). Subjects with knowledge of the law may make informed decisions to behave in a certain way, accordingly.

Lawyers negotiate the definitions of socio-legal constructs in relation to real situations, so that material facts can be detached from circumstances where it would be unjust to attach them. New situations that bring new factual additions, may require modifications to the definitional significance of facts. The detachment of facts from definitions of material facts is sometimes achieved by lawyers in the management of relevant evidence and through ontological arguments. Case epistemology makes provision for this.

It is not necessary to establish the same facts as a precedent case, in order to establish the necessary material facts of a rule of law that was satisfied in that case. A single fact, or a set of facts, may establish a material fact. A fact or set of facts is only ever one way of establishing a material fact. The potential for alternative single facts, or alternative sets of facts that establish the material fact, is maintained in case epistemology. There is always a Boolean 'or'; if it is represented in a rule system that includes fact rules as well as rules of law, it may be a fact rule with an antecedent 'other facts'. There may be an issue of whether facts are relevant and admissible in a case in order to fall within an 'other facts' alternative; this indicates the inter-relatedness of the epistemology of evidence, case epistemology and rule epistemology; the facts of a precedent case may be persuasive and assist in establishing relevance and admissibility, even though, in the doctrine of precedent, only rules of law are binding. Some differences in facts will not be fatal to a litigant's case, if they are decided in favour of the opponent.

Rules of law may also have Boolean 'or' knowledge structures. In eGanges, these are called fans; examples are given in the Figures below. In rule epistemology there is no imperative to keep open an unspecified rule of law as

a potential alternative to established rules of law. The attempt to add a new rule of law may begin as a proposal for a new fact rule or there may be a proposal for a modification of the existing system of rules of law. This is an epistemological characteristic that makes the distinction between facts and material facts, significant in determining what is an issue of fact and what is an issue of law, as well as what are the binding and persuasive parts of a judgment. It is not epistemologically adequate to use the concept 'factors' in a case reasoner, to blur the distinction.

Epistemological *dicta* in case judgment(s) must be considered in order to properly categorize facts and material facts. If there is no such *dicta* or the *dicta* is not clear, then the uncertainty must be noted for the purpose of applying the case to subsequent cases as a binding or persuasive precedent. It is sometimes difficult to determine what is material fact and what is mere fact, given available *dicta* as it is a judicial technique that is part of justice epistemology, to leave uncertainty in this regard, in the interests of a subsequent clearer context in which to confirm rule development from fact rules. A case reasoner should provide for these uncertainties.

Case epistemology does not distinguish deductive and inductive antecedents, or inconsequential (neutral) antecedents be they facts or material facts; nor is the place of antecedents in the hierarchy of an extended deductive argument given a knowledge structure. However, case epistemology does offer the opportunity to find analogies in its pathway of antecedents; analogy is a form of inductive argument.

There are other knowledge structures that are important in determining the significance of similarities and differences between the pathways of antecedents in a collection of cases. Similarities determine that these cases are a collection; their variations require knowledge structures that capture the significance of the differences for application to a user's case. These variations are best understood in the framework of rule epistemology. It is not epistemologically adequate to treat similarities and differences quantitatively without regard to their qualitative significance, particularly with regard to Final results. Decisive antecedents that produce a Final result are not apparent in the pathways of case antecedents. It is not even clear if all the antecedents on a case pathway are necessary and sufficient conditions that establish the Final result of the case. Rule epistemology is required to determine this.

Case epistemology is also concerned with semantic units that are not antecedents, of either a fact or material fact nature, in the case pathway to its Final result. Judgments may have considerable value as a source of abductive premises. Cases may be reported for new inductive iteration and abductive *dicta* even though they have no new facts or new material facts. Abductive *dicta* are part of justice epistemology.

Knowledge processing structures are required to match a user's facts to the facts or material facts of precedent cases. Four alternatives might constitute a knowledge processing structure:

- match to find applicable antecedents and pathways
- match to delineate partial applicable pathways in a collation of case pathways
- match to apply precedent pathways
- match to identify issues of evidence, issues of facts, and issues of law

Where there is a precedent case on all fours, a perfect match may produce all applicable rule(s) that can be seamlessly applied; there are no issues. This is rare. Case reasoners are mainly concerned to aid in assisting the formulation of arguments when there is not a perfect match. In order to do this, cases are treated as a collection of pathways of antecedents that lead to a Final result. The systemic organisation of the collection requires rule epistemology which contains rule system analysis and design.

Another form of case reasoning uses equity epistemology; this applies to some equity law. Equity epistemology is a form of case epistemology because it lies in the hybrid of rules and evidence. The paradigm of equity epistemology occurs when the fact(s) that establish a material fact, themselves alter the significance of facts that establish subsequent material facts. This usually occurs when a rule sets out a number of material facts that are to be considered in a discretionary way. For instance, in arriving at a division of matrimonial property, various factors such as the duration of the marriage and the contributions of the spouses might be material facts to weigh up. The shorter the marriage, the greater might be the weight given to contributions in reaching a decision. The weighing of factors is discretionary in each case; reasoning that is particular to each case is decisive, rather than the rule that sets out the material facts to be weighed by fuzzy discretion. Even for these equity rules, the facts can only ever be one way of establishing the material fact. Comparisons of case facts as alternative overlapping sets of necessary and sufficient conditions to establish a particular result encounter the same epistemological difficulties as rule system analysis and design. eGanges does not have a specific equity reasoning facility; it is thought that deeper granularity of fact rules might accommodate known persuasive cases, but this has not been tested in an application.

Case reasoners require a knowledge processing structure to receive user input that establishes the user's case. Inevitably this involves output questions for appropriate semantic units and input answers that will drive the matching process. Output structures are also required as knowledge processing structure. In eGanges, matching output is given in two ways: firstly as the case pathway of antecedents in the rule system and secondly as respective lists of hierarchical antecedents that support each party and how decisive these points are. This is further explained in the context of rule epistemology.

Rule epistemology

Rules of law and fact rules are epistemological structures that can be formalized in the logic structure of conditional propositions: if antecedent(s) then consequent. They are concerned with potential existences and future existences; their antecedents and consequents may be based on what has existed or what does exist. Rule epistemology uses the same discrete semantic units that are the material facts in case epistemology, as the antecedents and consequents of its rules of law. Facts may be treated as antecedents or consequents in fact rules, especially where, directly or indirectly, they establish a material fact. The distinction between fact rules and rules of law may be provided as an annotation to the rules, in the same way as might occur with a case reasoner.

Rules of law and fact rules may be used as premises in extended deductive legal argument; by delineating the scope for deductive legal argument, a rule system may also make provision for inductive and abductive premises as additions to the extended deductive argument. eGanges has knowledge structures to accommodate the division

of legal information into these three categories of premises available for legal argument.

Deductive premises

eGanges rule maps, which may be nested to accommodate extensive and complex rule systems, represent the rules of law and fact rules that can be used as premises in an extended deductive argument (Gray, 1988, 2002). This representation manages the rules as alternative overlapping sets of necessary and sufficient conditions that establish the Final result of the rule map. For instance Figure 1 is an eGanges rule map that represents the Australian Environment Protection and Biodiversity Conservation Act 1999 (Cth) s.18(1) which states:

A person must not take an action that:

- 1) has or will have a significant impact on a listed threatened species included in the extinct in the wild category; or
- 2) is likely to have a significant impact on a listed threatened species included in the extinct in the wild category.

Civil Penalty:

- a) for an individual - 5,000 penalty units;
- b) for a body corporate - 50,000 penalty units.

One Final Result implicit in the text of the section is: Successful prosecution of Environment Protection and Biodiversity Conservation Act 1999 s.18(1) offence (abbreviated as EPBCA s.18(1) offence). Alternatively the Final Result may be: No successful prosecution of EPBCA s.18(1) offence. A choice must be made from the available Final Results. In Figure 1, the final result selected is Successful prosecution.

The representation is a conversion of algebraically expressed conditional propositions into a user-friendly geometric expression that has a tributary structure like a river. Instead of a string of letters representing antecedents, followed by an arrow and then the letter representing the consequent, the geometric river is a string of labelled nodes, representing antecedents, connected by lines signifying conjunction, with the last line containing the algebraic arrow followed by the last node representing the consequent. The geometric substitute for the algebraic expression, provides objects that make object-oriented processing possible. These objects have the structure of a river because the arrow represents the flow of antecedence to consequence. The river flows represent the chaining paths implicit in extended deductive arguments; they are a knowledge processing structure. The order of antecedents in the flow may have some temporal or other significance. For instance, in contract law, there cannot be an acceptance until there is first an offer.

In order to arrive at the river formalization, the tributary paradigm must be identifiable in a system of rules. Antecedents and consequents must be seen to overlap in a way that allows them to be locked together to produce a tributary structure, so that each node is a unique semantic unit. Figure 2 is a paradigm set of rules that have a tributary knowledge structure and Figure 3 shows the tributary structure that results from locking the rules together geometrically at their points of overlap. The river system (Gray, 1988, 2002, Gray and Gray, 2003) is

like an Ishikawa fishbone (Ishikawa, 1985); Ishikawa fishbone diagrams were causal representations developed in Japan for quality control management. (See also Morgan, 2002 pp.122-5).

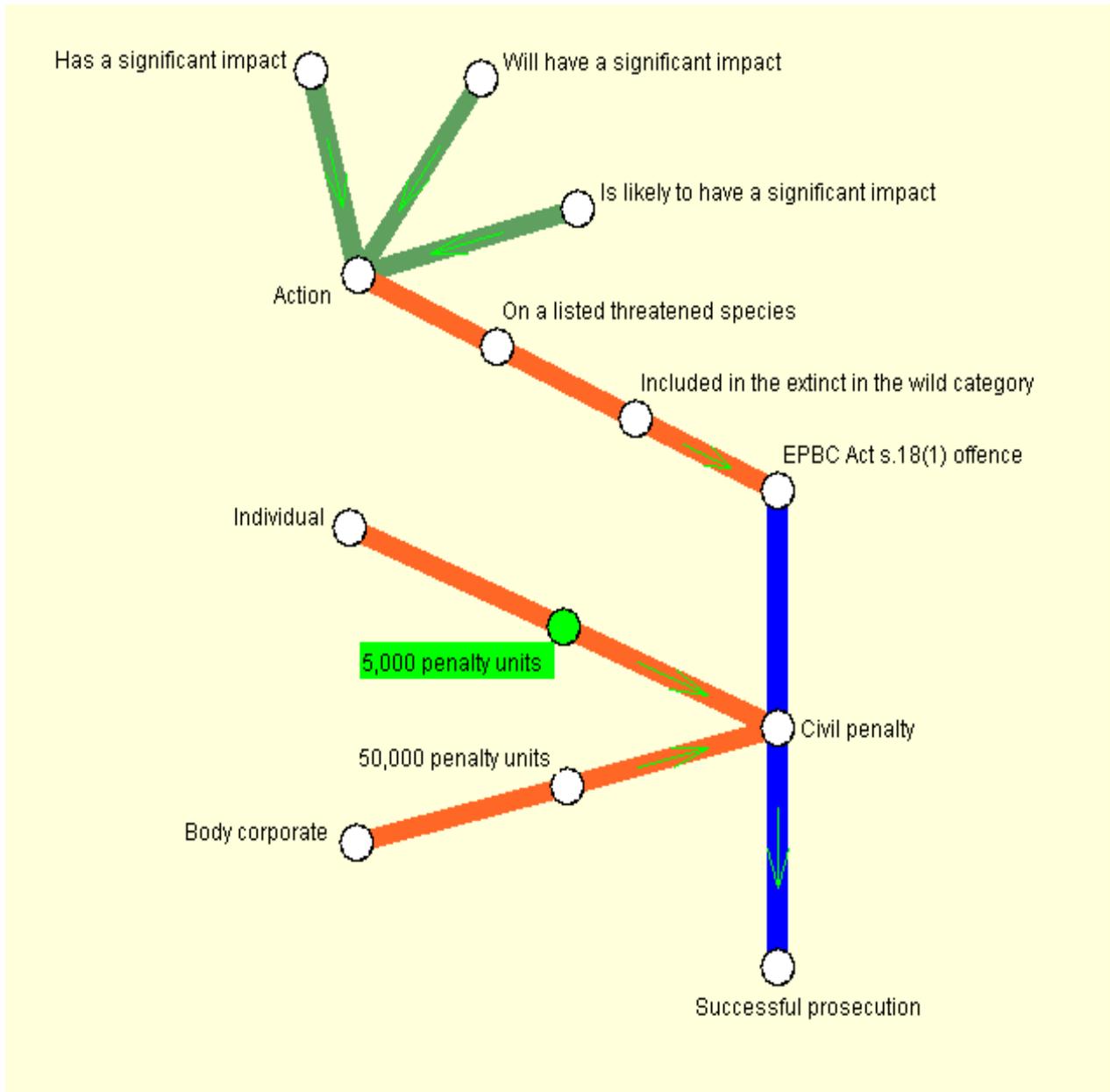


Figure 1 : EPBCA s.18(1) – Successful prosecution map

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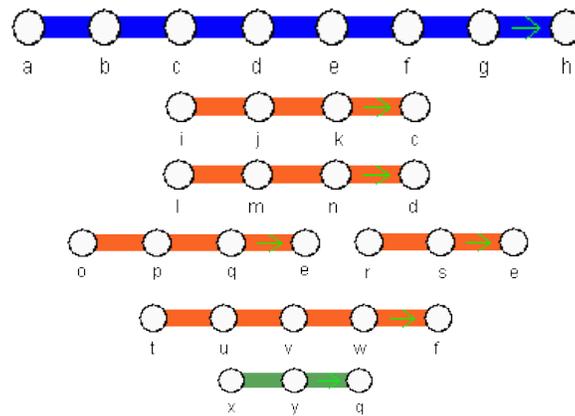


Figure 2: Wholly formalised rule streams

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In Figure 2, each node is labelled to indicate a concept that is an antecedent or a consequent in a rule. In the mainstream, that is listed first with nodes a-h, the antecedent c is also the consequent of the secondary stream that is listed second; similarly, d, e and f are antecedents in the mainstream and consequents in other secondary streams. The last river, which is a tertiary stream, particularises q, which is an antecedent in the third listed secondary stream. River systems are streamlined hierarchies with some common points. Similarly, in Figure 1, 'EPBC Act s.18(1) offence' is the consequent of a secondary rule and also the first antecedent in the mainstream rule.

The two secondary rules in Figures 2 and 3, that share the common consequent e can be understood as a fan that represents a Boolean 'or'. There are fans in Figure 1. For example, there are three alternative ways of establishing the required 'Action' for the offence, namely, if it has a significant impact, if it will have a significant impact, or if it is likely to have a significant impact. In any of these cases, there is the required 'Action'; this is a fan with three fanstreams. It is fans that produce a major characterization of rule systems as overlapping alternative sets of necessary and sufficient conditions that establish the Final result. Fans are Boolean structures in the knowledge that indicate alternatives and choice; their streams may be mutually exclusive or non-mutually exclusive. Different structures distinguish the 'and' and the 'or' aspects of the deductive premises. In the river hierarchy, the more upstreams that an antecedent has, then the more particularised or abstract it is. Many fields of law have extensive, complex river systems.

The rules of law in the Vienna Convention are an extensive system of premises that can be used in an extended deductive argument when the user's situation input establishes which antecedents in the rules apply in the user's case. It is an area of substantive law that is comparable to codified case law. Figure 4 shows the initial rule map of the Convention in the Rivers window of the eGanges interface. It is to be noted that the node, Net remedy, is derived from litigation epistemology. The nodes that look like soccer balls indicate nesting. Figure 5 shows the sub-map for the node Concluded contract. The soccerball nodes in Figure 5 indicate deeper levels of nesting.

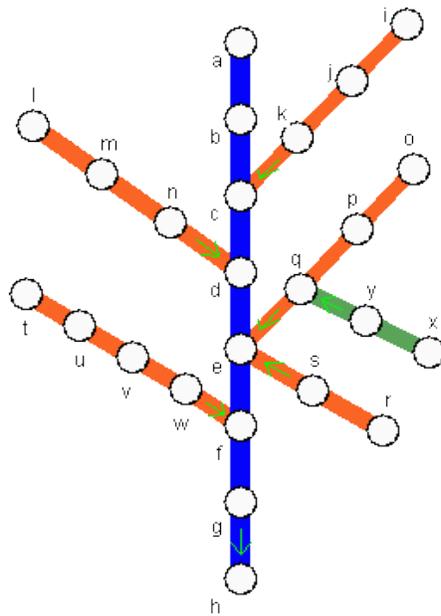


Figure 3: eGanges river map

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If an antecedent that is deeply nested fails, eGanges has a domino inferencing strategy that carries the effect of this through to the Initial map. Knowledge structures in case epistemology do not distinguish the hierarchical levels of nesting and do not indicate that a single deep failure may be responsible for the Final result of a precedent case. The more extensive and complex that the rule system is, the less likely that case epistemology will be useful in providing assistance in developing legal argument.

eGanges deals with negation and uncertainty of the antecedents in the river maps through its three Case windows, where the input premises available in the user's situation are listed according to the labels of the five available answer buttons. The epistemological phenomenon of neutral antecedents, that is, antecedents that are inconsequential to the Final result, are managed by the provision of three positive answer buttons that can be used instead of a set of one positive, one negative and one uncertain answers. A processing strategy is used in the sorting of answers, to accommodate Boolean alternatives in the sets of overlapping necessary and sufficient conditions; until all rules in a Boolean 'or' fan of rivers fail, negative answers will be shown as (Neg) in the Positive case window. Similar meta-rules govern the inferencing strategy that handles uncertainties.

The legal ontology in the initial map reveals the social epistemology of enforcing a net remedy where there is a breach of a contract for the international sale of goods. It is a social epistemology because it is a method of achieving social organisation. It is to be noted that the nodes that provide for Net remedy are derived from litigation epistemology, rather than the Vienna Convention itself. Further details of the legal ontology and its inherent social epistemology are set out in Figure 5. Figures 4 and 5 demonstrate a substantive ontology and

social epistemology governed by a generic legal epistemology.

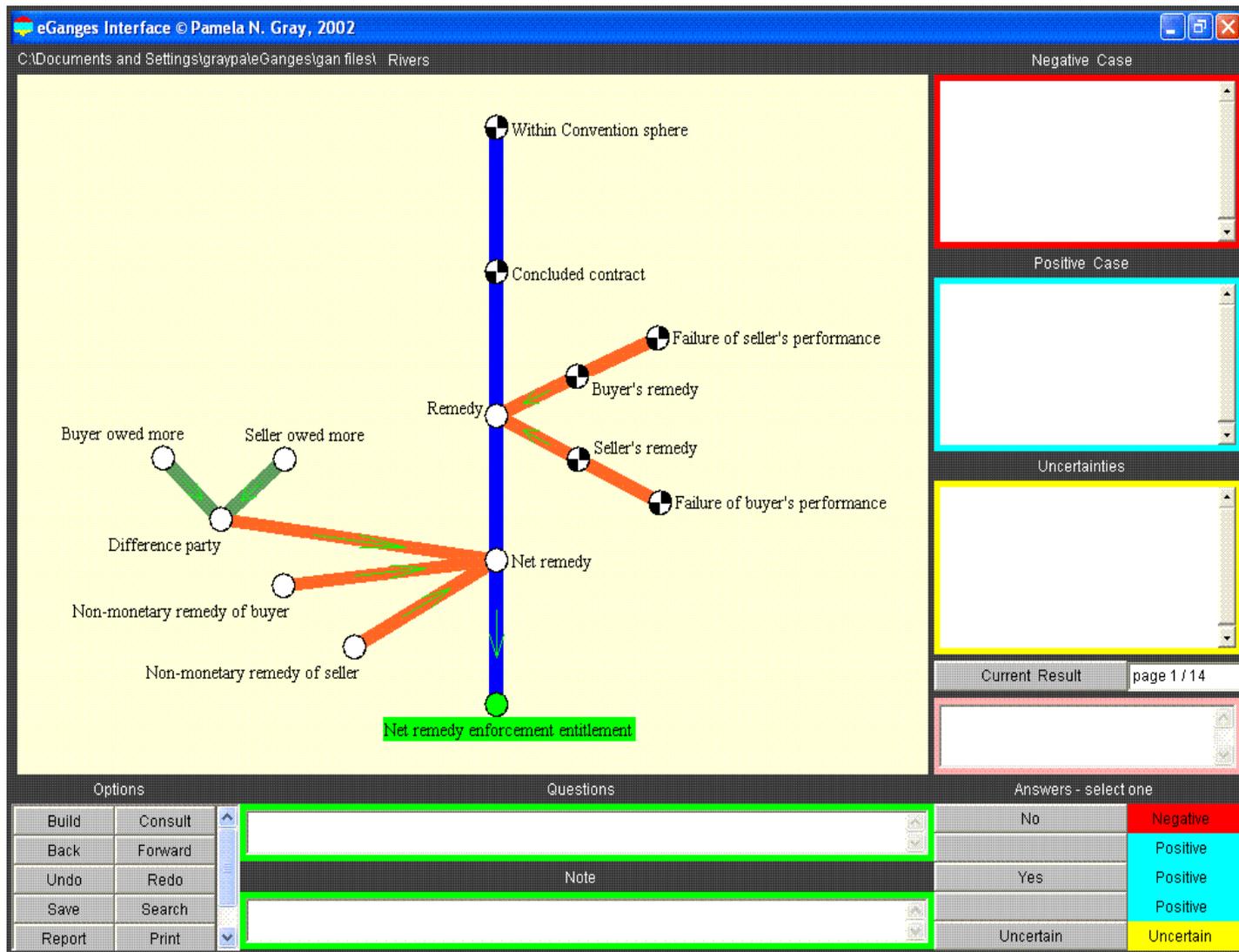


Figure 4: Initial map of the Vienna Convention

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Sometimes antecedents are stated in cases or legislation in a way that must be converted to its contradictory for inclusion in a river with a certain Final result. Case pathways do not indicate the significance of contradictory and uncertain antecedents. Because rules are concerned with potential fact situations, a rule system must provide for every contradictory antecedent as well as the uncertainty of every antecedent. There are other deductive premises that can be used as argument pathways to the failure of the Final result (Uncertainties) or the contradictory Final result (Negative case). They complete the full scope of the adversarial pathways for opponents in legal argument.

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The contradictory and uncertain rules are not shown in the eGanges visualization; such a visualization requires a three dimensional structure, a sphere, that is difficult to navigate. However, the three dimensional deductive structure is implemented in the knowledge processing structures and the inferencing strategy of the eGanges shell functionality.

Diversion to failure of the Final result may occur at any point along the river because of the rule that all antecedents on the rule map must be established in order to reach the Final result, except where there is a Boolean 'or' indicating alternatives.

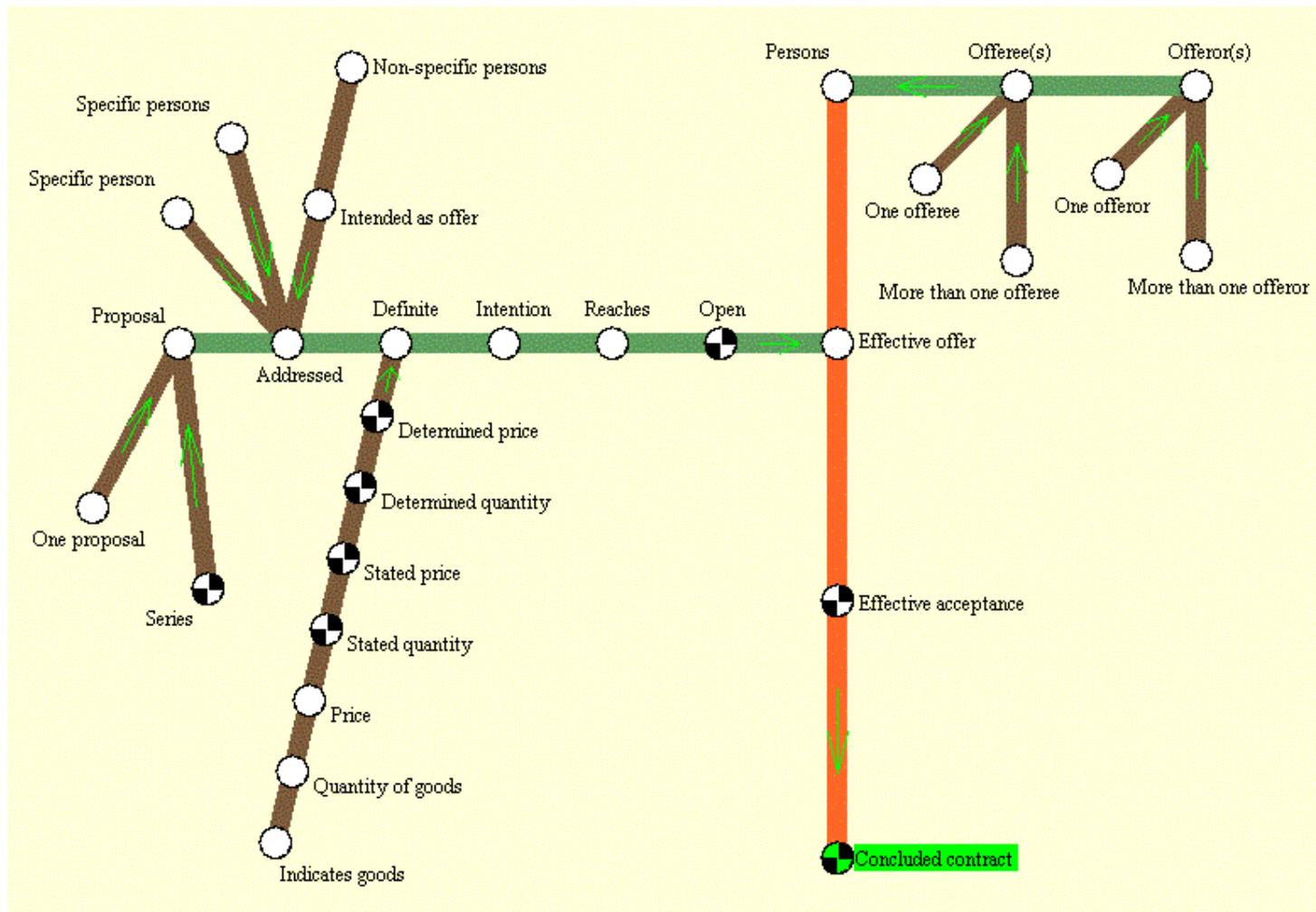


Figure 5: Concluded contract submap - Vienna Convention

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The functionality of eGanges is threefold:

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- a. Sorting answers into Case windows:
- b. Showing the Final result in a Case window when the necessary and sufficient conditions are established to do so
- c. Showing the Current result in the Current result window in response to clicking the Current result button.

Meta-rules that are inferencing strategy manage the prioritization of negative antecedent accumulation and uncertain antecedent accumulation for Final result processing, as well as fan processing. The potential for combinatorial explosion of possible cases to which the rule system may apply, is also controlled by the spherical logic meta-rules.

Inductive and abductive premises for legal argument are made available through the gloss facilities of eGanges. The inductive premises are provided for in the spectrum gloss and the abductive premises are provided for in other types of glosses. The iteration of inductive instances in the spectrum gloss, permits a semantic evaluation of whether an argument is available by virtue of analogous instances, authoritative iteration, or both. A case has one pathway through the alternative sets of necessary and conditions in the spherical logic structure.

Conclusion

A case reasoner is not epistemologically sound unless it adopts the knowledge structures, knowledge processing structures, and inferencing strategy of rule epistemology. eGanges offers this form of case reasoning to process a user's case and see its context in the whole system of rules, including the reasons that it carries a certain Final result. These reasons reflect the complexity of the overlapping sets of necessary and sufficient conditions that are used in inductive legal argument and the choices that they contain. The pathway of any precedent case may be plotted through the eGanges rule system for comparison with a users case.

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