Plausibility Schemas: Templates for Legal Factfinding

Vern R. Walker
Hofstra University School of Law, 121 Hofstra University
Hempstead, New York 11549, USA
1(516)463-5165; vern.r.walker@hofstra.edu

ABSTRACT
This paper describes a default-logic framework (plausibility schemas) and software tools (Decision Apprentice™ and Legal Apprentice™) for modeling, guiding and automating the reasoning from evidence in a legal record to a finding of fact.

Keywords
Default logic, non-monotonic logic, evidence assessment

1. INTRODUCTION
The problem addressed is how to model, guide and evaluate the reasoning from the evidence in a legal record to a finding of fact (the result of factfinding). Patterns in such reasoning must be studied empirically, because factfinding balances epistemic against non-epistemic objectives [2]. The epistemic objective is to make findings of fact that are as accurate as possible, based on the limited evidence available. Examples of non-epistemic objectives are procedural fairness to parties and substantive governmental goals (e.g., an adequate supply of vaccines).

2. PLAUSIBILITY SCHEMAS

2.1 The Concept of a Plausibility Schema
Plausibility schemas are products of the formal logic approach of schematizing patterns of inference, so that substitution for variables will create plausible inferences. (This approach contrasts with that behind argumentation schemes, which orchestrate dialogues and shift a burden of presumption.) Plausibility schemas are inverted, directed, acyclic graphs consisting of analyzed evidentiary assertions and plausibility connectives, with the root node representing the conclusion of a conditional, and lower-level nodes representing its conditions.

Legal rules determine which findings are relevant in a particular legal case, and a default-logic framework for modeling legal rules has been presented elsewhere [3, 4, 5]. Plausibility schemas model the default reasoning patterns that are actually used, or which ought to be used, by factfinders in applying those rules.

Each schema is based on a theory of uncertainty – a theory about the sources of potential error inherent in the schematized inference pattern [1]. A primary goal is to capture in the schema conditions all of the major sources of uncertainty, so that the inference is warranted unless its defeat is warranted. An optimal schema would incorporate scientific methodology, and thus be able to integrate expert and non-expert evidence.

Software exists for creating and applying plausibility schemas, developed in two forms by Apprentice Systems, Inc. The Decision Apprentice™ software creates plausibility schemas themselves, using Microsoft Office Visio™ as a graphical environment for selecting and connecting "smart" Visio shapes to create schemas. The Legal Apprentice™ software uses standard text-tree controls to instantiate the schemas into inference models for particular legal cases. Details about the Legal Apprentice software and a free "Student Edition" are available at www.legalapprentice.com.

2.2 A Plausibility Schema for Categorizing an Individual through Measurement
Although this research abstract cannot present the full ontology of plausibility schemas, an example of one fundamental pattern of reasoning is categorization through measurement – reasoning that warrants that a specific individual is in a particular category on the basis of observations. Figure 1 shows the first level of a plausibility schema based on scientific measurement methodology (space limitations prevent discussing the theory of this schema).

Figure 1 shows a Decision Apprentice graphic with assertion shapes as nodes. An assertion is the informational content of a declarative sentence or clause, which can be meaningfully assigned a plausibility-value (a degree of plausibility assigned by the factfinder). An assertion is analyzed by identifying its logical subjects (objects or events referred to, and about which the assertion makes a statement). Darker oval shapes embedded in the assertion shapes identify the logical subjects.

Figure 1 also illustrates two plausibility connectives (operators that assign a plausibility-value to the conclusion as a function of the plausibility-values of the conditions): "minimum" ("MIN"), which assigns a plausibility-value to the conclusion that is equal to the lowest plausibility-value possessed by any of its conditions; and "rebut" ("REBUT"), which, whenever the rebutting condition is plausible to any degree (i.e., its plausibility-value is positive), assigns a plausibility-value to the conclusion that is inverse to that of the rebutter (that is, the conclusion's plausibility-value is negative, and to the same degree as the rebutting condition is positive).

Two additional plausibility connectives useful in modeling evidence assessment in law are "maximum" and "undercut" [3].

2.3 Instantiating Plausibility Schemas
A factfinder, attorney, or researcher can instantiate a plausibility schema by substituting the names of specific individuals for the schema subjects, and can evaluate the instantiated schema by assigning plausibility-values to the terminal assertions. Figure 2 shows (in the text-tree format of Legal Apprentice) an instantiation of an extended version of the inference tree in Figure 1, using these substitutions for subjects: "Individual I" =

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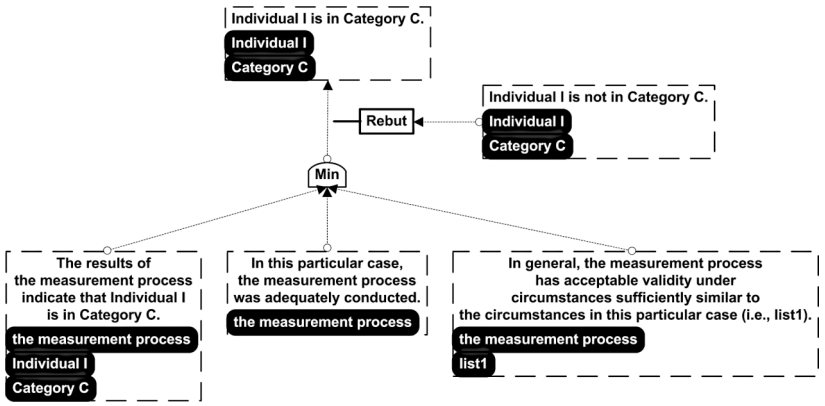

Figure 1: High-Level Plausibility Schema for Individual Categorization through Measurement (Decision Apprentice™ Shapes)

"J. Jones"; "Category C" = "the category of males of medium height"; "the measurement process" = "visual perception"; "list1" = "dusk, at a distance of 25 meters."

In Figure 2, some instantiated evidentiary assertions are evaluated as "highly plausible," "very plausible," or "slightly plausible" (indicated by an evaluation line immediately below an evaluated assertion, and by a gray-scale circle icon before the assertion). The plausibility of the ultimate conclusion at the top of this instantiated schema, however, remains "undecided" (indicated by a white circle icon in front of it) as long as the first-level assertion "MIN[2 of 3]" is undecided (whether, "in this particular case, visual perception was adequately conducted").

3. CONCLUSION

Plausibility schemas can model and help evaluate the reasoning that links the evidence in a legal record to a finding of fact. They can also facilitate the automation of legal factfinding (as shown by the Decision Apprentice and Legal Apprentice software).

Theoretical and empirical work is now underway to design sets of schemas for modeling the reasoning in actual factfinding. A working hypothesis is that modeling requires relatively few plausibility schemas, grouped under four major archetypes: categorization of individuals (e.g., measurement as discussed above); generalization of models about groups of individuals; application of models to individuals; and identification. Because plausibility schemas are based on logic and scientific methodology, they are also useful for modeling practical reasoning in knowledge domains other than law.

4. ACKNOWLEDGMENTS

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5. REFERENCES

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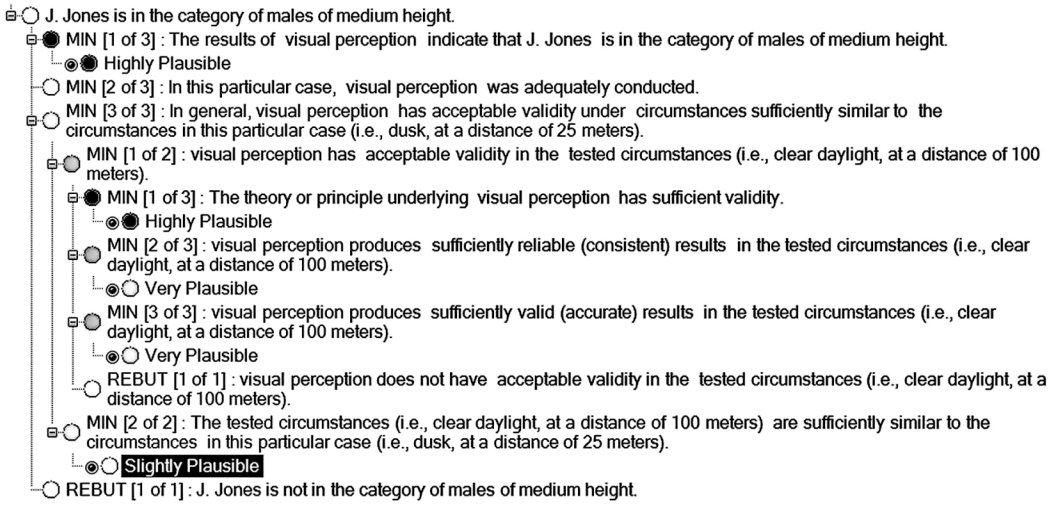

Figure 2: Instantiated and Evaluated Plausibility Schema for Individual Categorization (Legal Apprentice™ Text Tree)