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LAWGICAL: JURISPRUDENTIAL AND LOGICAL CONSIDERATIONS

JOHN P. FINAN*

Mastering the lawless science of our law — that codeless myriad of precedent, that wilderness of single instances.

Tennyson, Aylmer's Field

I. INTRODUCTION: LOGICAL BASIS OF THE LAWGICAL SYSTEM

IN AN OFT-QUOTED PASSAGE, Justice Douglas stated in *Bank of Marin v. England*, "we do not read these statutory words with the ease of a computer."¹ The case itself illustrates one of the difficulties involved in using computers to perform legal reasoning. The Court of Appeals² had actually read the language of the Bankruptcy Act³ with the ease of a computer, that is, literally, and had imposed liability on a bank for paying a check drawn on the bankrupt's account after the petition in bankruptcy had been filed, but before it had knowledge or reason to know of the filing of the petition. Justice Douglas held that this was a harsh result. Invoking "overriding" equitable considerations,⁴ he declined to read the statute so as to impose such inequitable consequences upon the bank, despite the clear statutory language.

Such "creative" statutory construction is familiar to anyone who reads appellate decisions.⁵ Whatever one's views on so-called strict construction, one must recognize that in the actual working of law, this type of creative interpretation is prevalent. One who designs a computer system to do some aspects of legal analysis must take into consideration the creative dimension of the judge's role. Otherwise the computer will "calculate legal results" which are literally correct but faithless to the law as it is actually interpreted. It would be easy to design a system to draw legal inferences if one accepted a mechanical, slot machine jurisprudence. However, whatever view one takes on the subject, slot machine jurisprudence does not capture what the courts actually do. Thus, any computer system based upon mechanistic assumptions would be useless to the practitioner.

This analysis applies with equal force to the application of logic to law.

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¹ 385 U.S. 99, 103 (1966).

² 352 F.2d 186 (1965).

³ 11 U.S.C. § 110(d)(5) (1976) (repealed 1978).

⁴ 385 U.S. at 103.

⁵ See Shafer, *Precedent and Policy*, 34 U. CHI. L. REV. 3 (1966); B. CARDOZO, *THE NATURE OF THE JUDICIAL PROCESS* (1921).

One might say that logic is the mechanism by which experience is translated into concrete legal results. A helpful example is provided by Professor Cleary,⁶ who suggests the following formula for the rule holding dog owners liable at common law: + ownership + notice of dangerous character + biting. He then illustrates a statutory refinement of this rule: + ownership + biting — being tormented — unlawful presence on the premises. He cites Michael and Adler⁷ to the effect that rules of substantive law are:

statements of the specific factual conditions upon which specific legal consequences depend. . . . Rules of substantive law are conditional imperatives, having the form: *If such and such and so and so, etc. is the case, and unless such and such or unless so and so, etc. is the case, then the defendant is liable.*⁸

Cleary then remarks that, "this view of the substantive law may seem unduly Euclidean, yet some system of analysis and classification is necessary if the law is to possess a measure of continuity and to be accessible and usable."⁹

A critic might suggest that the Euclidean approach raises more problems than it solves. What is ownership? What is torment? When is presence unlawful? Was the animal who did the biting a dog or a wolf? These questions might seem fanciful to a lay person but not to a lawyer, who knows the difficulty of definition and is mindful, for example, that the Uniform Commercial Code¹⁰ defines "purchase" to include "gift." The problem, though real, is not overwhelming, for it is the user of the computer in an interactive mode who must know the definition of terms (who must know, for example, that purchase includes gift) in order to enter the proper truth value of a particular sentence. The user is not without recourse, however, for the displayed text can remind him.

LAWGICAL performs the deductive aspects of legal reasoning in an interactive mode. It circumvents the problems illustrated by *Bank of Marin* by leaving to the user the humanistic-creative judgments and by assigning to the computer only those logical non-creative operations which the computer, and a logician, can perform. Thus, it may be argued that the computer has escaped the Scylla of open-textured problems only to be engulfed by the Charybdis of triviality. Indeed, Justice Holmes' epigram that "the life of the law has not been logic, it has been experience,"¹¹ is frequently

⁶ See Cleary, *Presuming and Pleading: An Essay on Juristic Immaturity*, 12 STAN. L. REV. 5 (1959).

⁷ Michael & Adler, *The Trial of an Issue of Fact: I*, 34 COLUM. L. REV., 1224, 1241 (1934).

⁸ Cleary, *supra* note 6, at 6 (emphasis in original).

⁹ *Id.* at 7. See also Frank, *Mr. Justice Holmes and Non-Euclidean Legal Thinking*, 17 CORNELL L.Q. 568 (1932).

¹⁰ U.C.C. § 1-201(32) (1977). All further references in text or footnotes to the U.C.C. are to this edition.

¹¹ O. HOLMES, *THE COMMON LAW* 114 (1927). The epigram stated in full reads:

The life of the law has not been logic: it has been experience. The felt necessities of the time, the prevalent moral and political theories, intuitions of public policy, avowed

cited by those who aver that deductive logic has either no place at all in legal analysis, or at best a trivial role to play. Support for that view is also found in Bishin and Stone who state, "We have seen . . . that the syllogism works so effortlessly because the real energy is expended in ascertaining the major and minor premises."¹² Or, in the context of an interactive computer program it might be argued that, before the computer computes a legal consequence, the coder and the user in an interactive mode have expended all the real energy. Thus, the question must be squarely faced whether all the effort involved in creating a computer analysis to perform some aspects of legal analysis is "worth the candle." The answer, in this author's opinion, is an emphatic yes for several reasons. While logic and its tool, the computer, cannot determine the premises which, in the words of Justice Holmes, are the "very root and nerve of the whole proceeding,"¹³ they can and do isolate the root and nerve.

Justice Holmes, in the language quoted above, speaks of intuitions of public policy avowed or unconscious. Felix S. Cohen writes that, "an ethics, like a metaphysics, is no more certain and no less dangerous because it is unconsciously held."¹⁴ According to Cohen, judges, as well as psychoanalysts and economists, employ a "formula" designed to cause all moral ideals to disappear and to "produce an issue purified for the procedure of positive empirical science."¹⁵ Cohen does not believe that ethics, thus banished, remain irrelevant. He states that "the ideals have generally retired to hats from which later wonders will magically arise."¹⁶

A historical school of law disclaims concern with ethics and repeatedly invokes a *Zeitgeist* or a *Volksgeist* to decide what the law ought to be. An analytical school of jurisprudence again dismisses questions of morality, and again decides what the law ought to be by reference to a so-called logical ideal, which is not an ideal of logic at all, but an aesthetic ideal of symmetrical analogical development. Those who derive the law from the will of the sovereign usually introduce without further justification the premise that it is good to obey that will. And those who define law in terms of actually prevailing social demands or interests

or unconscious, even the prejudices which judges share with their fellowmen, [sic] have had a good deal more to do than the syllogism in determining the *rules* by which men should be governed. *Id.* (emphasis added).

¹² W. BISHIN & C. STONE, *LAW, LANGUAGE AND ETHICS* 51f (1972).

¹³ Holmes, *The Path of the Law*, 10 HARV. L. REV. 457, 466 (1897). The complete quotation reads: "The language of judicial decision is mainly the language of logic. And the logical method and form flatter that longing for certainty and for repose which is in every human mind. But certainty generally is illusion, and repose is not the destiny of man. Behind the logical form lies a judgment as to the relative worth and importance of competing legislative grounds often an inarticulate and unconscious judgment, it is true, and yet the very root and nerve of the whole proceeding." *Id.* at 465-66.

¹⁴ F. COHEN, *THE ETHICAL BASIS OF LEGAL CRITICISM* 3 (1959).

¹⁵ *Id.*

¹⁶ *Id.*

make frequent use of the undisclosed principle that these demands *ought* to be satisfied.¹⁷

One advantage of the use of logic in law is that it serves as a tool to uncover that hidden ethical premise from which legal reasoning proceeds. Cohen continues: "The objection, then, is not that jurists have renounced ethical judgment but that they have renounced ethical science. Ethical science involves an analysis of ethical judgments, a clarification of ethical premises."¹⁸ But it is impossible to analyze ethical judgments or clarify ethical premises unless they are uncovered. If premises remain unconscious and intuitive, as Justice Holmes suggests, they cannot be articulated; and without articulation, they cannot be analyzed or clarified. Debates are sterile or at least not edifying. Cohen observes that:

Among the current legal crypto-idealisms there can be no edifying controversy, since there is no recognition of the moral issues to which their differences reduce. One looks in vain in legal treatises and law-review articles for legal criticism conscious of its moral presuppositions. The vocabularies of logic and aesthetics are freely drawn upon in the attempt to avoid the disagreeable assertion that something or other is intrinsically better than anything else. Particular decisions or legal rules are "anomalous" or "illogical," "incorrect" or "impractical," "reactionary" or "liberal," and unarguable ethical innuendo takes the place of critical analysis.¹⁹

This is not to suggest that logical analysis, whether symbolic logic or the logic used in a computer system, will mechanically determine cases. As Cohen states:

It is often important to conserve with new obeisance the morals which lawyers and laymen have read into past decisions and the reliance upon which they have acted. We do not deny that importance when we recognize that with equal logical justification lawyers and laymen might have attached other morals to the old cases had their habits of legal classification or their general social premises been different. But we do shift the focus of our vision from a stage where social and professional prejudice wear the terrible armor of Pure Reason to an arena where human hopes and expectations wrestle naked for supremacy.²⁰

In commenting on this excerpt, Bishin and Stone ask:

Is it possible to reason about ethics—about what is "good" and "bad," "moral" and "immoral"? Or are such judgments all "just a matter of opinion"? Consider in this regard the maxim, *de gustibus non disputandum*,²¹ and Cohen's remark that certain problems are problems

¹⁷ *Id.* (emphasis in original).

¹⁸ *Id.*

¹⁹ *Id.*

²⁰ *Id.* at 7.

²¹ Concerning taste (values?) there can be no dispute.

"not of logic but of ethics." Are ethical judgments simply a matter of taste? Is there no 'logic' to them?²²

Such questions as these are beyond the scope of the LAWGICAL system. Instead, its designers have attempted to divorce the creative function of law from its mechanical counterpart by programming the machine to draw deductive inferences and by leaving the creative judgments to the user in an interactive mode. To the extent that LAWGICAL successfully separates the "wheat from the chafe" it is useful to the practitioner since it performs a trivial but tedious job of logical analysis. The practitioner is thus left free to perform the creative functions unhindered by any commitment to any particular school of jurisprudence.

Is the determination of the truth value of particular premises completely alogical, as suggested by the above commentators? Justice Cardozo quotes Lord Halsbury in *Quinn v. Leathem*, to the effect that:

[A] case is only an authority for what it actually decides. I entirely deny that it can be quoted for a proposition that may seem to follow logically from it. Such a mode of reasoning assumes that the law is necessarily a logical code, whereas every lawyer must acknowledge that the law is not always logical at all.²³

Commenting on this statement, Justice Cardozo notes that:

All this may be true, but we must not press the truth too far. Logical consistency does not cease to be a good because it is not the supreme good. Holmes has told us in a sentence which is now a classic that "the life of the law has not been logic; it has been experience." But Holmes did not tell us that logic is to be ignored when experience is silent.²⁴

The statements by both Holmes and Cardozo quoted above suggest that logic has something to do with not only (1) reasoning *from* premises but also (2) reasoning *to* premises. There is no question that, once experience has given us the premise in a particular case, the premise must be applied to the facts of a new case by deductive logic. Whether the creation of the premise from experience is itself a product of logic is quite another matter; and it is in this area that one may legitimately debate about the relation of logic to law. One cannot, it is submitted, legitimately debate the first of these propositions, for once the premise has been established, deductive logic necessarily comes into play. Cardozo says:

I am not to mar the symmetry of the legal structure by the introduction of inconsistencies and irrelevancies and artificial exceptions unless for some sufficient reason, which will commonly be some con-

²² BISHIN & STONE, *supra* note 12, at 35.

²³ 1901 A.C. 495, 506.

²⁴ CARDOZO, *supra* note 5, at 32-33.

sideration of history or custom or policy or justice. Lacking such a reason, I must be logical, just as I must be impartial, and upon like grounds.²⁵

Symmetry is an aesthetic, not a logical, ideal, and whether a distinction makes a difference is an ethical, not a logical question. The same may be said about the question whether a distinction is irrelevant or artificial. If a premise can be reasoned to deductively, that fact suggests that there is another premise which forms the basis of the deductive inference. This premise in turn may not be reasoned to unless, once again, there is a further premise on which to base the next deductive inference. Eventually there must be an unreasoned-to premise and this is the "root and nerve of the whole proceeding," which may not be supplied by deductive logic. The role of logic and of LAWGICAL is to expose the penultimate premise and to compute legal results by the mechanical rules of deductive inference. To the extent that these goals can be accomplished, the practitioner will not only be aided in a practical sense, but he will also experience graphic exposure to the various components of his own reasoning process: the deductive and the inductive; the creative and the analytical, the semantic and the syntactic.

II. DRAFTING AND LAWGICAL

A. "Normalization"

Normalized legal drafting techniques developed by Professor Laymen E. Allen²⁶ have been used, and will continue to be used, in the development of data bases for LAWGICAL. Allen and Engholm have stated that, "*normalized legal drafting* is a mode of expression expressing ideas in statutes, regulations, contracts, and other legal documents in such a way that the syntax that relates the constituent propositions is simplified and standardized."²⁷ They add that, "this 'normalization' results in documents that are easier to understand in the dual sense that they can be read faster and more accurately than corresponding documents that are not normalized."²⁸

The sentences in normalized drafts are what logicians call "simple" or "atomic" as opposed to those that are compound or molecular.²⁹ It is possible to draft statutory and other legal rules so that they are composed of "atomic" sentences and compound sentences which, in turn, are made up of atomic sentences joined together by logical operators. To the extent that the logical operators are truth functional, advantage can be taken of programs already in a system (such as those supplied in APL) which can

²⁵ *Id.* at 33.

²⁶ See Allen & Engholm, *Normalized Legal Drafting and the Query Method*, 29 J. LEGAL EDUC. 380 (1978).

²⁷ *Id.*

²⁸ *Id.*

²⁹ See M. SCHAGRIN, *THE LANGUAGE OF LOGIC* 7 (2d ed. 1979).

compute the truth value of compound sentences if given the truth value of constituent sentences.

A truth-functional compound (molecular) sentence is a sentence made up of constituent sentences, joined by the following truth-functional connectives: "if," "if and only if," "only if," "and," "or," and "not." All of the above connectives, except "not," are two-place connectives, *i.e.*, their grammatical rules provide that they combine with two sentences to make a compound sentence. "Not" is a one-place connective. It combines with a single sentence to form a compound sentence.³⁰

According to Copi, "every statement is either true or false, so we can speak of the *truth value* of a statement."³¹ The truth value of a true sentence is true, and that of a false sentence is false.³² The terms "sentences," "statements" and "propositions" are used interchangeably above, although, technically, a proposition is the meaning of a sentence and not the sentence itself.³³ Copi also observes that, "Any compound statement whose truth value is completely determined by the truth value of its constituent [atomic] statements, regardless of whether they are true or false, is a *truth-functionally* compound statement."³⁴ To take a simple example, if "p" represents one statement and "q" represents another, and if the statement "p" is true and the statement "q" is true, then the compound statement "p & q" is true. Otherwise it is false, *i.e.*, if either "p" is false or "q" is false, then the statement "p & q" is false.

B. *Ambiguous Operators: "Or"*

The operator "or" presents difficulty since it has two meanings. It may be an inclusive "or" or an exclusive "or." This ambiguity occasionally, though infrequently, is resolved by a rule of construction. The Bankruptcy Reform Act of 1978, for example, provides that "or" is not exclusive.³⁵ According to the notes of the Committee on Judiciary, "Paragraph (5) specifies that 'or' is not exclusive. Thus if a party 'may do (a) or (b),' then the party may do either or both. The party is not limited to a mutually exclusive choice between the two alternatives."³⁶ The act's rule of construction is

³⁰ See B. CHELLAS, MODAL LOGIC 26 (1980) who says that "true" and "false" are "zero-place operators, or constants," "not" is a "one-place operator," and " \wedge , \vee , \rightarrow , and \leftrightarrow are two-place operators." He states also that necessity and possibility are one-place operators. The necessity operator is discussed at pp. 696-97 *infra*.

³¹ I. COPI, SYMBOLIC LOGIC 11 (1954).

³² *Id.*

³³ F. FITCH, SYMBOLIC LOGIC 5-9 (1952).

³⁴ COPI, *supra* note 31, at 11. Note that not all molecular sentences are truth functional. The one-place operators, necessity and possibility, *supra* note 30, and the deontic operators combine with simple sentences to form non-truth-functional molecular (compound) sentences. For a discussion of deontic logic, whose operators are "shall" (it is obligatory) and "may" (it is permissible), see CHELLAS, *supra* note 30, at 190.

³⁵ 11 U.S.C. § 102(5) (Supp. IV 1981).

³⁶ S. REP. No. 989, 95th Cong., 2d Sess. 28, reprinted in 1978 U.S. CODE CONG. & AD. NEWS 5787, 5814.

consistent with the systems program in APL which treats the word "or" as an inclusive "or." Thus, if the coder wishes to state "a or b but not both," he must state "(a or b) and not (a and b)."

It has been noted by way of contrast that in Latin, "*vel*" represents the inclusive "or" and "*aut*" the exclusive "or."³⁷ To indicate the inclusive disjunction in English, however, one must say either "a or b or both" or must resort to "and/or," a usage condemned by style manuals as a barbarism. Barbaric or not, "and/or" is frequently used in legal discourse. And there is simply no notation that unequivocally expresses the exclusive "or." "Or" is sometimes interpreted as inclusive and sometimes as exclusive, so using the simple word "or" will not do. "A or b but not both," though cumbersome, seems to be the only effective way to indicate clearly that an exclusive disjunction is intended.

C. "And": Functor or Connective?

The word "and," unlike the word "or," is not ambiguous when used as a connective. However, its use can create difficulties. One such problem is illustrated by an Ohio statutory provision which reads: "'and' may be read 'or' and 'or' may be read 'and' if the sense requires it."³⁸ Apart from difficulty in determining whether "and" is a notation not for the word "and," but for the word "or," there are additional difficulties with the word. It is sometimes simply impossible to determine the scope of the conjuncts. An illustration frequently employed by Professor Laymen Allen is the statement, "doctors and lawyers qualify." Does it mean (1) that doctors qualify and lawyers qualify or (2) that those who are *both* doctors *and* lawyers qualify? If it means the latter, one speaks of the subject of the verb, qualify, as being the logical intersection, the set product, of the terms. Thus we have but one constituent (atomic) sentence. If, on the other hand, we treat it as set union, we have two constituent sentences.

This difficulty is not limited to hypothetical situations. Allen writes³⁹ of *State v. Hill*,⁴⁰ in which the court was faced with a statute which read, "no person shall engage in or institute a local telephone call, conversation or conference of an anonymous nature and herein use obscene, profane, vulgar, lewd, lascivious or indecent language, suggestions or proposals of an obscene nature and threats of any kind whatsoever."⁴¹ The defendant Hill, had concededly made no specific threats but he had allegedly used words to the effect that he desired sexual intercourse with the woman he had called. The trial court dismissed the prosecution, reading the statute to

³⁷ I. COPI, *INTRODUCTION TO LOGIC* 251 (4th ed. 1972).

³⁸ OHIO REV. CODE ANN. § 1.02(F) (Page 1978).

³⁹ See Allen & Engholm, *supra* note 26, at 384.

⁴⁰ 245 La. 119, 157 So.2d 462 (1963).

⁴¹ 245 La. at 120, 154 So. 2d at 462.

require both obscene language *and* threats. On appeal, the prosecution, relying upon legislative history, argued that the word "and" should be read disjunctively. With respect to this argument, Allen and Engholm suggest that:

This same position can be expressed differently—and more persuasively—to achieve the same results. Instead of the straining argument to interpret the "and" as "or" to achieve the legislative intent, the more persuasive argument is merely to interpret "and" as a full-sentence connecting "and" rather than a sentence-part connecting "and."⁴²

The authors also offer a normalized version of the Louisiana statute and state:

The results of this normalizing process are two ways of normalizing the Louisiana statute that regulates anonymous telephone conversations (1) by converting its ambiguous within-sentence syntax into unambiguous between-syntax, and (2) by merely disambiguating the relevant aspects of its within-sentence syntax. From the viewpoint of facilitating the more extensive use of computers in helping to process and analyze legal prose the first alternative is preferable. It could be written as follows:

If

1. a person engages in or institutes a local telephone call, conversation, or conference of an anonymous nature, and
2. (A) that person therein uses obscene, profane, vulgar, lewd, lascivious or indecent language, suggestions or proposals of an obscene nature, or

(B) that person therein uses threats of any kind whatsoever,
then

3. that person has engaged in unlawful behavior.⁴³

It should be noted that the trial court's reading of the statute treated the word "and" as a "functor," whereas the prosecution argued that it should be treated as a sentence connective.⁴⁴ The difficulty is that one must resort to context or to legislative history in order to determine whether the "and" was intended to be a functor or a connective. One drafting a statute in normalized form would be forced to make the selection, and that poses no problem. The translation of a statute into normalized form, however, does create difficulties, because drafting in such form requires that one consistently identify which of the sentences are the constituent sentences and which are the connectors (logical operators). One cannot do this simply by treating all "ands" as connectives, for, as shown above, "and" is not always a connective.

⁴² Allen & Engholm, *supra* note 26, at 385.

⁴³ *Id.* at 399.

⁴⁴ A functor combines with two names to make a name; a connective combines with two sentences to make a new sentence (a compound or molecular sentence). For an excellent discussion of this distinction, see W. McMahon, *Did Montague Invent "Montague Grammar"?* (1982), (unpublished manuscript available at the offices of the AKRON L. REVIEW).

D. Negation: Problems in Distribution

The word "not" is a one-place connective; that is, it combines with a sentence to make a new sentence. If it combines with a constituent (atomic) sentence, there is usually no difficulty. There is great difficulty, however, when, as is frequently the case, it combines with a compound (molecular) sentence unless the drafter makes it clear whether the negation ranges over the molecular sentence or one or both of its constituents (*i.e.* of its disjuncts or of its conjuncts). For example, "not (p or q)" is not equivalent to "not p or q" and it is not equivalent to "not p or not q."

The relationship between "and" and "or" was discussed above. When two connectives are used (*e.g.*, "not" and "and" or "not" and "or") interpretation difficulties multiply. Under DeMorgan's rule, a disjunction may be converted into a conjunction and a conjunction may be converted into a disjunction if (1) the quality (*i.e.*, either affirmative or negative) of the conjunction or disjunction is changed and (2) the quality of each of the disjuncts or conjuncts is changed.⁴⁵ Thus, "not (p or q)" is equivalent to "not p and not q."⁴⁶

Sometimes the difficulty is obscured because rather than the literal negation, "not," a term such as "without", "fail", or "unless" is employed.⁴⁷ Section 3-302(1)(c) of the Uniform Commercial Code offers an example. It defines a holder in due course as a holder who "takes the instrument . . . without notice that is overdue *or* has been dishonored *or* of any defense against or claim to it on the part of any person." In normalizing this sentence, one must recognize that the word "without" is a negation which ranges over a disjunction composed of three disjuncts. In order to indicate clearly, for computer processing, that each of the disjuncts is separate, one would find it necessary to distribute.⁴⁸ However, to distribute by normalizing the statute to read that one is a holder in due course if he takes the instrument without notice that it is overdue, or without notice that it has been dishonored, or without notice of any defense against or claim to it on the part of any person, would clearly mistranslate the statute, because the holder must take without notice of all three conditions in order to be a holder in due course. The distribution of the negation demands, under DeMorgan's rule, that the "or" be changed to "and." Stated symbolically, the statute

⁴⁵ Augustus DeMorgan (1806-1871), a mathematician and logician, stated this rule, which has been given the following formulation: "the negation of the {disjunction} of two statements is logically equivalent to the {conjunction} of the negations of the two statements." *COP1*, *supra* note 37, at 281.

⁴⁶ ~~Not not~~ (not p & not q); the negatives ranging over the conjunctions cancel each other out.

⁴⁷ "Unless" is generally interpreted to mean "if not."

⁴⁸ Not (a or b or c) when distributed reads "not a and not b and not c." This result is justified by DeMorgan's rule,

as enacted reads “not (p or q or r).” With distribution and the use of DeMorgan’s rule, the statute comes to read “not a and not b and not c.” Failure to recognize that the “or” should be changed to “and,” *i.e.*, that DeMorgan’s rule applies, would lead a coder into difficulty.

A more subtle version of this problem is created by use of the word “fail,” and is illustrated by a recent case, *In re Adoption of McDermitt*.⁴⁹ In *McDermitt* a referee’s report had recommended approval of the adoption of Eddie by the appellee because the appellant parent had failed without justifiable cause to support Eddie for at least one year before the filing of the petition for adoption. The issue was whether the adoption required the objecting parent’s consent. The relevant portion of the applicable statute reads, “when . . . the court finds . . . that [a natural] parent has failed without justifiable cause to communicate with [a] minor *or* to provide the maintenance and support of the minor . . . [consent of that parent] to adoption is not required.”⁵⁰ The parent argued that “or” should be read to mean “and,” pointing to Ohio Revised Code section 1.02(F).⁵¹ But the court found that the phrase in question is unambiguous, its sense not requiring “or” to be read as “and.”⁵² It thus rejected the parent’s assertion that the phrase, “communicate with the minor *or* provide for the maintenance and support of the minor,” must be read conjunctively. Stated symbolically, the court’s finding was that the parent had “failed to do p” under a statute interpreted to impose certain legal consequences⁵³ if he “failed to do p or failed to do q.”

If the court had read “failed” to range over the disjunction “p or q,” then, under DeMorgan’s rule it would have interpreted the statute to read, “if appellant failed to do p *and* failed to do q.”⁵⁴ Instead it concluded that the negative ranged over each of the disjuncts, *i.e.*, consent is not required if the parent *fails* to do p *or fails* to do q. Whether this is the appropriate construction of the statute is beyond the scope of this article. It might be said, with tongue in cheek, that the court’s reading is wrong since “failed” appears only once and thus is literally undistributed. The difficult point for purposes of coding is that the use of a negative requires a determination of its appropriate scope. A coder normalizing this section might well be pardoned for assuming that the word “failed” ranged over the disjunction or even only over the first disjunct, since it was not repeated. Had the legislature intended the *McDermitt* result, the statute arguably would have read, “consent to adoption is not required of any of

⁴⁹ 63 Ohio St. 2d 301, 408 N.E.2d 680 (1980).

⁵⁰ OHIO REV. CODE ANN. § 3107.07(A) (Page 1980) (emphasis added).

⁵¹ See text accompanying note 37 *supra*.

⁵² 63 Ohio St. 2d at 303, 408 N.E.2d at 682.

⁵³ The “legal consequences” were that consent of the natural parent is not required for adoption.

⁵⁴ “Not (p or q)” is equivalent to “not p and not q” under DeMorgan’s rule.

the following: a parent of a minor when . . . the court finds . . . that the parent has either *failed* . . . to communicate with the minor or has *failed* to provide for maintenance and support of the minor." Such language would make it clear that the negation is distributed. The section as drafted makes it anything but clear, and the *McDermitt* court did not address the problem of the range of negation. Instead, it assumed that the issue was whether "or" rather than "and" had been intended.⁵⁵

Whatever may be said of the correctness of the *McDermitt* result on policy grounds, the interpretation difficulty is not created by any ambiguity in language but rather by ambiguity in syntax, a problem that must be faced by coders whenever statutes are normalized. Lawyers analyzing statutes must also deal with syntactic ambiguity. It is simply not the case that a literal reading of "or" solves the problem. If the terms "and" and "or" are used and distribution is shown by the use of parentheses, either of the two meanings can be expressed by use of "and," and either can be expressed by use of "or." Consider the following equivalencies:

- 1) "Not p or not q" is equivalent to "not (p and q)"
- 2) "Not p and not q" is equivalent to "not (p or q)"

These equivalencies, in ordinary language may be expressed as follows:

- 3) "If a natural parent fails to communicate *or* fails to support, s/he suffers the legal detriment" is equivalent to "if a natural parent fails both to communicate *and* support, s/he suffers the legal detriment."
- 4) "If a natural parent fails to communicate *and* fails to support, s/he suffers the legal detriment" is equivalent to "if a natural parent fails either to communicate or to support, s/he suffers the legal detriment."

Intuitively, number 4 is the most difficult to grasp. The natural parent would argue, "I lose my right if I fail to do either; I did not fail to do either; I communicated." The argument can be grasped better with use of "neither . . . nor": "If a natural parent neither communicates nor supports, s/he suffers the legal detriment." Here, the intuitive meaning is compelling; it takes two failures to lose your rights.

E. *Conditional Operators*

In addition to the connectives considered above, the law uses conditional operators. There are three types of conditions: those that are necessary, those that are sufficient, and those that are both necessary and sufficient. According to Copi, "A *necessary* condition for the occurrence of a specified event is a circumstance in whose absence the event cannot occur."⁵⁶ He offers, as an

⁵⁵ In support of its conclusion that "and" should not be read as "or," the *McDermitt* court cited at length from *In re Estate of Marrs*, 158 Ohio St. 95, 99, 107 N.E.2d 148, 150 (1952), where the court had addressed a similar issue.

⁵⁶ I. COPI, INTRODUCTION TO LOGIC 322 (3d ed. 1968).

example, the necessity of oxygen for combustion and states "if combustion occurs, then oxygen must have been present, for in the absence of oxygen there can be no combustion."⁵⁷ Thus, the presence of oxygen is a necessary condition for combustion; however, it is not a sufficient condition: "A *sufficient* condition for the occurrence of an event is a circumstance in whose presence the event must occur."⁵⁸ Copi explains that, "the presence of oxygen is not a sufficient condition for combustion because oxygen can be present without combustion occurring."⁵⁹ Frequently, a condition is both necessary and sufficient, *i.e.*, the result must occur in the presence of the condition and in the absence of the condition the event cannot occur.

In law, a sufficient condition is often indicated by use of the word "if" standing alone; a necessary condition is indicated by "only if"; and a condition both necessary and sufficient by "if and only if" or "if but only if." However, this usage is not consistently followed. Contrast, for example, sections 623A and 649 of the Restatement of Torts.⁶⁰ Section 623A states three conditions disjunctively and indicates the conditional by the words "if, but only if." Use of this phrase is evidence that the drafters of the Restatement were sensitive to the distinction. However, section 649 (conditional privilege of competitors) uses only the word "if," although the context makes clear that the condition is both sufficient and necessary. The contextual (intuitive) reading is compelling because the provision reads in part, "a competitor is conditionally privileged to make an unduly favorable comparison . . . if the comparison does not contain false assertions of specific unfavorable facts." The provision would be ludicrous if the condition, that specific unfavorable facts must not be contained, were absent. If one has any doubt that use of the word "if" gives rise to ambiguity, one need merely consult the many, many cases discussing the maxim *expressio unius est exclusio alterius*. Application of that maxim indicates a court's belief that "if" was intended to read "if and only if." A court which states that *expressio unius* does not apply reads the "if" to mean just that, "if."

A third type of ambiguity arises with the use of "only if." For example, section 363(h) of the Bankruptcy Reform Act of 1978,⁶¹ gives the trustee in bankruptcy the power to sell both the estate's interest and a co-owner's interest in certain property *only if* four conditions are met. The conditions are stated conjunctively. The truth of the conjunction is a necessary condition of the trustee's power to sell the property; *i.e.*, all of the conjuncts must

⁵⁷ *Id.*

⁵⁸ *Id.*

⁵⁹ *Id.*

⁶⁰ RESTATEMENT (2d) OF TORTS §§ 623A, 649 (Tent. Draft No. 13, 1967) (now superseded).

⁶¹ 11 U.S.C. § 363(h) (Supp. IV 1981). A. COHEN, BANKRUPTCY, SECURED TRANSACTIONS AND OTHER DEBTOR-CREDITOR MATTERS 140 (1981), *e.g.*, paraphrases the statute using the term "if."

be true or the trustee lacks the power. However, if the conjunction is true, *i.e.*, if all of the conjuncts are true, does it follow that the trustee is empowered by this section to sell the property? The answer depends upon whether the truth of the conjunction is a sufficient as well as a necessary condition. Lawyers intuitively read the condition as sufficient. It might be argued that, had the legislature intended the condition to be sufficient, it would have used the term "if and only if." However, in the judgment of this writer, this is a case where "only if" is used ambiguously to indicate "if and only if."

III. RESOLVING AMBIGUITY: POSSIBLE APPROACHES

A. The "Else" Line

Some programming languages have a design format which alerts the drafter to the ambiguity, and forces him either to resolve the ambiguity or to be deliberately ambiguous:⁶²

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if _____
then _____
else _____

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Generally, those who draft statutes and other documents leave the "else" line blank. When a statement reads "if p then q" and the client's fact situation indicates that p is true, a court simply infers that q is true and does not concern itself with the content of the "else" line. However, when, as often happens, the fact situation is "not p" instead of "p," then it is critical to discover the content of the "else" line. It is when confronted with this construction problem that courts invoke the maxim, *expressio unius est exclusio alterius*, which means "expression of one thing is the exclusion of another."⁶³ Courts applying the maxim, invariably conclude that "not q" is to be inserted on the "else" line, just as they uniformly conclude that the maxim does not apply when "not q" is not contained in the else line. When "not q" is not contained in the else line, it is generally considered to be a "*casus omissus*," *i.e.*, "a case omitted; an event or contingency for which no provision is made; particularly a case not provided for by the statute on the general subject, and which is therefore left to be governed by the common law."⁶⁴

Professor Reed Dickerson concludes that the use of *expressio unius est*

⁶² Although LAWGICAL does not employ this format, it is a useful one for an "ordinary language" explanation of the normalizing problems a coder faces. It is also useful as a prompter for an original drafter (legislator, will drafter, etc.).

⁶³ BLACK'S LAW DICTIONARY 521 (rev. 5th ed. 1979).

⁶⁴ *Id.* at 198.

exclusio alterius is anachronistic, and quotes with approval an earlier statement in which he had described the maxim as:

a rather elaborate, mysterious sounding, and anachronistic way of describing the negative implication. Far from being a rule, it is not even lexicographically accurate, because it is simply not true, generally, that the mere express conferral of a right or privilege in one kind of situation implies the denial of the equivalent right or privilege in other kinds. Sometimes it does and sometimes it does not, and whether it does or does not depends on the particular circumstances of context. Without contextual support, therefore, there is not even a mild presumption here. Accordingly, this maxim is at best a description, after the fact of what the court has discovered from context.⁶⁵

While it seems clear that *expressio unius* is nothing more than what has been called "a rule of justification,"⁶⁶ its persistent appearance in the reported cases is evidence that, unless the drafter fills in the "else" line, some court will inevitably be compelled to do so.

If legislators were to, as a uniform practice, use "if" to indicate any sufficient condition, "only if" to indicate any necessary condition, and "if and only if" to indicate any sufficient and necessary condition, much needless litigation, not to mention anxiety on the part of office practitioners, would be avoided. Another legislative solution for this problem would be consistent use of the if , then , else format. If a condition were merely sufficient, the draft should read "if p, then q, otherwise *casus omissus*." For a merely necessary condition, *i.e.* only p then q, the draft would read, "if not p then not q, else *casus omissus*." To indicate both a sufficient and a necessary condition, the draft would read "if p then q, else not q."

Ambiguity of the terms "if" (which may mean "if" or "if and only if") and "only if" (which may mean "only if" or "if and only if") is compounded by the practice of expressing statutory conditionals in non-conditional form. For example, the hypothetical statement, "(for every x); (if x is a man, x is mortal)" can be put categorically rather than hypothetically, as follows: "all men are mortal." Such a categorical statement, for purposes of normalization, can be translated to a hypothetical statement. Once again, however, the question is whether the proper translation is "if" or "if and only if." It is common learning that if the predicate is "distributed," the statement means all men are *all* mortals, and "if and only if" is the proper translation. But if the predicate is undistributed, if the statement means all men are some mortals, then the "if" translation is appropriate. Common sense tells us that, if all men are *all* rational animals and Fido is not a man, Fido is

⁶⁵ R. DICKERSON, *MATERIALS ON LEGAL DRAFTING* 129 (1981) *citing* R. DICKERSON, *THE INTERPRETATION AND APPLICATION OF STATUTES* 234 (1965).

⁶⁶ G. GOTTLIEB, *THE LOGIC OF CHOICE* 103-104 (1968).

not a rational animal. However, if all men are *some* rational animals, *i.e.*, if there are rational animals other than men, then we may not infer from the fact that "Fido is not a man" that "Fido is not rational." It follows that, whether statutes are written in categorical or hypothetical form, the distinctions among necessary conditions, those which are sufficient, and those which are both, cannot be avoided by one translating into normalized form.

In LAWGICAL, if the user assigns a premise a true value, the conclusion is assigned a true value; if a false value, the conclusion is assigned no value. However, LAWGICAL does not ignore the problem treated above. If the user does not assign a true value, LAWGICAL displays a message indicating that the implication has failed. Then the user must test the result of falseness by a separate implication. Thus a separate implication for the complement (falseness) of the conclusion must be available in the data base. This requirement poses the difficulty of interpretation explored above, for if Reed Dickerson is correct that no maxim such as *expressio unius* or "negative inference" can solve our problem, the question is, what should be put in the data base when the premise is false. For the drafter of a statute who is also writing the analysis, the solution is easy. He makes a choice and inserts it. Difficulties arise when the analyst is someone other than the drafter. If the statute uses the term "if and only if" (*i.e.*, if and only if p and q then r) it is clear that the data base should assign the value "not r " when the premise is evaluated as false. However, "if" is frequently used alone, and it is common knowledge that "if," standing alone, is often ambiguous. Furthermore, unlike conditionals, which are sometimes made unequivocal by use of "if and only if," rules written in categorical form are almost never explicit. One may encounter a rule such as "*all* holders in due course take free of claims," but will not find one that reads "all holders in due course are *all* persons who take free of personal defenses." Such "quantification" is simply not found in drafts. Resolution of the ambiguity is left to judicial determination, a generally unsatisfactory approach. The court gets a "feel" for the appropriate meaning and mouths some maxim such as *expressio unius* to articulate that "gut feel."

B. *Negative Inference or Casus Omissus?*

The problem of negative inference, or, really, the scope of a statute, frequently arises under uniform acts. For example, U.C.C. section 1-103, a provision similar to those found in other uniform acts, reads:

Unless displaced by particular provisions of this act, the principles of law and equity, including the law merchant and the law relative to capacity to contract, principal and agent, estoppel, fraud, misrepresentation, duress, coercion, mistake, bankruptcy, or other validating causes shall supplement this provision.

The Code offers little guidance for the application of this doctrine apart from section 7-105 which reads: "Construction against Negative Implication. The

omission from either Part II or Part III of this article of a provision corresponding to a provision made in the other part does not imply that a corresponding rule of law is not applicable.”

The official comment to this section indicates that its purpose is “to avoid any impairment, for example, of any common law right of indemnity, a warehouseman may have corresponding to § 7-301(5), or of any contractual security interest a carrier might have corresponding to § 7-209(2).”

It is immediately apparent that the problem of negative inference is identical to that of what goes on the “else” line, namely, either (1) the denial of line 2 (the then line) or (2) *casus omissus*. Section 7-105, where applicable, directs that *casus omissus* be inserted. In other areas, the courts are left at large as they are with the Code’s repealer provisions. Section 10-102 reads: “the following acts and all other acts and parts of acts inconsistent here with are repealed,” followed by a list of the specific acts repealed. The difficult construction problem is to determine the meaning of “all other acts and parts of acts inconsistent herewith.” The general repealer, section 10-103, has similar language: “except as provided in the following section, all acts and parts of acts inconsistent with this act are hereby repealed.” If a prior act allows a discharge if any one of five conditions occurs (a or b or c or d or e) and the Code allows a discharge in the case of a or b or c or d, the question is whether e survives. The Code rule may be stated in either of the following ways consistent with the language:

- 1) If a or b or c or d,
then discharge,
else no discharge.
- 2) if a or b or c or d,
then discharge,
else *casus omissus*.

The adoption of one of these versions will determine whether common law under section 1-103 or statutory law under sections 10-102 or 10-103 survives; or, conversely, whether statutory or common law is to be displaced. If the *casus omissus* construction is adopted, common law and prior statutory law survive; otherwise they do not. The following two cases offer an excellent illustration of this problem.⁶⁷

Hargrove held that a statutory version of the doctrine of *Pane v. Packard*⁶⁸ survived the enactment of the U.C.C. *Philadelphia Bond* held to the contrary that the doctrine, at least to the extent that it applied to the class of accommodation parties as opposed to the class of sureties, did not survive enactment of the Code. The Code has many defenses identical with non-

⁶⁷ *Philadelphia Bond & Mortgage Co. v. Highland Crest Homes, Inc.* 17 U.C.C. Rep. Serv. 158 (Pa. Super. 1975); *First Nat’l Bank v. Hargrove*, 503 S.W.2d 856 (Tex. Civ. App. 1973).

⁶⁸ 13 Johns, 174, 7 Am. Dec. 369 (N.Y. 1816).

Code common law suretyship defenses (see especially section 3-606). The question is whether these Code defenses are exclusive, so as to displace common law, or inclusive, allowing common law and prior statutes to survive. The Code drafters did not resolve the issue. The drafter of a normalized statute would be forced to do so; otherwise the statute would be incomplete. Since the Code drafters were obviously aware of this problem (witness section 7-105), one must surmise that they left the issue of the survival of suretyship defenses deliberately ambiguous. Given the importance of non-codified suretyship defenses, this approach seems unfortunate. In any event, one who translates the U.C.C. into normalized form must address this issue, since normalization forces one to consider whether a condition is sufficient, necessary, or both sufficient and necessary.

C. *LAWGICAL Applications*

The above review suggests that the *LAWGICAL* format which allows the user to perform the semantic functions and the computer to compute the legal consequences may create difficulties. The user determines semantics, the machine computes consequences, but the coder must decide whether a condition is necessary or sufficient or both; whether the scope of the conjunction is a full sentence or a name (*i.e.*, is a functor or a connective); whether a disjunction is inclusive or exclusive; and whether a negative ranges over the disjunction or conjunction, as the case may be, or only over individual disjuncts or conjuncts. Thus a user may, with justification, complain that the program may not produce a correct analysis, even if he has correctly supplied the truth value of the constituent (atomic) sentences. This is a major drawback but not fatal to the usefulness of *LAWGICAL*. The coder can take appropriate actions to eliminate the difficulty. For one thing, he can update the data base whenever a case or other authority (*i.e.*, administrative agency, Revenue Ruling) makes it clear that the coder's choice is incorrect. Furthermore, coders can work closely with experts whose tentative analyses will be at least as reliable as statements in legal texts⁶⁹ whose authors must make similar assumptions.

Just as the author of a legal text may express doubt and explain alternative possible constructions of a statute, the coder creating a data base may do the same. For example, the "else" line, the separate analysis assigning false to a conclusion in *LAWGICAL*, may read: "not q if the legislature intended the enumeration to be exclusive; otherwise there is a *casus omissus*." The coder may even expand this analysis by stating, *e.g.*: "there are seven cases and three Revenue Rulings suggesting that there is a *casus omissus*; however, there is an article in the X Law Review strongly urging, on policy grounds, that the negative inference should be drawn." It might be argued that such qualifications in the data base would make the displayed

⁶⁹ See *e.g.*, COHEN, *supra* note 61, at 140, who translates "only if" to mean "if" without commenting that, in doing so, he has interpreted the statute.

text unwieldy. The coder could probably avoid excess verbosity, however, by alerting the user to the ambiguity and directing him to cases and other material which should help to resolve it. Thus, while the computer performs its function of freeing the user from having to draw deductive inferences, it would compel him to determine the proper syntactical relations of the premises to the conclusion. Of course, forcing the user to do additional work would decrease the usefulness of the system. However, the computer would still help the user to make the syntactic judgments by directing him to the appropriate literature. Furthermore, in some cases, a user's simple discovery that there is an ambiguity may solve his problem without further ado. For example, a user who approached LAWGICAL with the understanding that the court would use the maxim *contra proferentem* to interpret a statute would find his task completed once the computer indicated ambiguity.

Obviously ingenuity in coding is necessary to make the data base useful. On some occasions, the coder can do no better than to alert the user that whatever consequences are drawn depend upon assumptions made by the coder. Even in those circumstances LAWGICAL can be useful. For one thing, the user can test his own conclusions about the meaning of a statute against the expert judgment of the coder. (It is assumed that those who code will have expertise in the particular body of law coded.) Furthermore, even a user insufficiently familiar with a body of law to have made any prior tentative assumptions against which to test the coder's conclusions may benefit, for LAWGICAL allows the user to trace the coder's steps and to observe his reasoning.⁷⁰ At a minimum the user is then exposed to a competent reasoning process, a role model.

It might be asked to what extent such exposure is superior to the use of a treatise, text or hornbook. There are two advantages, the first of which is speed. Second, the computer computes deductive inferences which the user must draw for himself when he analyses a body of law unaided by a computer. The second advantage may be minimal when the deductive inferences are relatively easy to draw. However, certain areas of the law, like those of bankruptcy or taxation, involve deductive inferences which, though trivial, require a great deal of mental effort. Here the computer performs a very valuable service. As an analogy, no one would use a calculator to multiply 5 times 6, but that fact certainly does not preclude its use for other calculations, even though one could obtain the same result by use of pencil and paper. Also, the computer is unlikely to make a mistake in drawing deductive inferences, whereas lawyers may well do so when the inferences become sufficiently complex. Thus, the computer has an advantage in its ability to assure the user that, once premises have been

⁷⁰ See Welch, *LAWGICAL: An Approach to Computer-Aided Legal Analysis*, 15 AKRON L. REV. 655 (1982).

identified, the remaining legal reasoning, the deductive aspects, will be properly computed (drawn).

Professor Purtell offers an interesting metaphor which might be applied to LAWGICAL. Speaking of logical operators (what we refer to as truth functional connectives) he states:

Propositions are like the sticks in a Tinker Toy set; without the round spools or connector blocks, you can do very little with the sticks. Operators are like the connector blocks; by adding them to propositions we get more complex structures. Most operators do, in fact, connect propositions and will be called *connectives*. But some operators do something to a single proposition. It is rather like putting one stick into one connector block: It can then stand up where previously it could only lie in a horizontal position.⁷¹

Frequently sufficiently few "sticks" are used in a legal problem that the deductive inference can be drawn intuitively with confidence. There, a computer system is virtually useless, offering as much assistance as does a calculator to multiply 2 times 2. However, many fields of law involve numerous "sticks" used in combinations whose complexity baffles our intuitions. In those cases, lawyers must resort to deductive logic and there the computer can be helpful. If deductive aspects of legal reasoning are trivial, they are so only when the deduction is properly performed. If the deduction is improperly performed, the mistake is fatal, no matter how accurate the lawyer may have been in determining the truth value of constituent sentences. For example, if a tax lawyer, after an outlay of considerable intellectual energy, were to discover that the amount of tax due was \$5,263 x 5,242, the remaining calculation would be trivial indeed. However, if the lawyer then made the calculation incorrectly, his mistake would not be trivial, it would be momentous. The same may be said of deductive logic. It is significant only when done incorrectly.

D. *Identifying the Constituent Sentences*

An additional difficulty is raised by the application of normalization techniques to sections such as U.C.C. 9-301, for example, which reads: "An unperfected security interest is subordinate to the rights of (1)(b) a person who becomes a lien creditor before the security interest is perfected." The difficulty is in identifying the constituent sentences, which could be:

- 1) A person has a security interest
- 2) A security interest is perfected
- 3) A lien creditor obtained his lien prior to perfection
- 4) The security interest is subordinate to the rights of the lien creditor

⁷¹ R. PURTELL, *LOGIC FOR PHILOSOPHERS* 5 (1971). It should be noted that the "single stick" is the so-called one-place connective. So far, only the one-place connective, "not," has been discussed. Two other one-place connectives, the alethic and the deontic, so-called non-truth-functional connectives, are discussed at pp. 696-97 *infra*.

With syntactic connectives the sentence would read:

If
 a person has a security interest,
 and
 the security interest is perfected,
 and
 a lien creditor obtained his lien prior to perfection,
 then
 the security interest is subordinate to the rights of the lien creditor.

This restatement is incomplete. It does not address a priority dispute between (1) a holder of a security interest which is never perfected and (2) a lien creditor. If, however, we add the following constituent sentence, (5) "the security interest is unperfected," we then, by adding syntactic connectives, restate the law completely without sacrificing accuracy:

[If a person has a security interest
 AND
 the security interest is unperfected]
 OR
 [the security interest is perfected
 AND
 a lien creditor obtained his lien prior to perfection]
 THEN
 the security interest is subordinate to the rights of the lien creditor.

In order to formulate sentence number 5, the coder must interpret section 9-301(1)(b), because that proposition is implicit, rather than explicit, in the statutory formulation found in that section.

One advantage of using normalization in initial drafts is that it alerts the drafter to just this type of problem. Had the Code drafters constructed the sentences in normalized form and then added syntactic connectives, they would have made express what is now merely implicit in section 9-301. They would also have greatly aided students who generally find the section confusing, perhaps because the subject of the sentence is "an *unperfected* security interest" and the predicate states a rule respecting the time the security interest is *perfected*. Such drafting invites confusion because the actual subject of the predicate is not the articulated subject. The subject completely expressed, would read somewhat awkwardly, "an unperfected security interest or a security interest which is perfected when or after a person becomes a lien creditor." Such a subject, however, makes part of the predicate redundant. (*I.e.*, it makes the italicised portion of the following sentence redundant: "An unperfected security interest is subordinate to the rights of (b) a person who becomes a lien creditor *before the security interest is perfected.*") The inconsistency between the subject and the predicate in the present draft is perhaps not too significant, since common sense overrides imprecise

drafting and yields the appropriate result. Nevertheless, viewed solely from the point of view of drafting, section 9-301 is at best unfortunate. It is especially so for the person who "normalizes" it, for the drastic surgery required invites charges that the meaning has been altered in the normalization process.

The following two sentences would have avoided difficulty without being awkward:

- 1) an unperfected security interest is subordinate to the rights of (b), a person who becomes a lien creditor.
- 2) a perfected security interest is subordinate to the rights of a person who became a lien creditor before the security interest was perfected.

E. *Syntactic Ambiguity: Negating the Deontic "Shall"*

A further normalization difficulty may be illustrated by yet another statutory provision, found in the Bankruptcy Reform Act of 1978, which reads "'may not' is prohibitive and not permissive."⁷² Thus, the question of whether the phrase "X may not do" means "X (may not) do"; or "X may (not do)," is resolved at least for purposes of this act, although not in other contexts. The word "shall" creates a similar problem when it is used deontically (*i.e.*, when "X shall" means "X is obliged").⁷³ The difficulty becomes especially acute whenever "shall" is followed by a strong "unless."⁷⁴ "Unless" is a negative meaning "if not." Therefore, one must consider what the negative of the deontic "shall" is when "shall" and "unless" are used together. The negation of the deontic "shall" poses difficulty because "All men shall do" may be negated as:

- 1) (a) It is not the case that all men shall do
or
(b) Some men (shall not)⁷⁵ do, *i.e.*, some men are not obliged to do
or
(c) Some men may (not do); some men are permitted not to do but not as
- 2) (a) All men (may not) do, (all men are obliged not to do)
or
(b) No man may do.

Another possibility is:

⁷² 11 U.S.C. § 102(4) (Supp. IV 1981).

⁷³ See C. REMBAR, *THE LAW OF THE LAND*, 311 (1980), who suggests that the word "shall" means "something has got to be done."

⁷⁴ A "weak" unless is equivalent to "if . . . not . . ." A "strong" unless is equivalent to "if and only if . . . not . . ."

⁷⁵ Treating the negation as a negation of "shall" makes it an "external" negation. See A. ROSS, *DIRECTIVES AND NORMS* 151 (1968).

3) "Some men shall (not do)"⁷⁶ - some men are obliged not to do"?

Sentences 1 and 3 are obvious candidates to express the negation of "shall." It is difficult to decide between them, a difficulty which must be addressed since its resolution determines whether "shall" followed by a strong "unless" produces: (1) a double obligation as with sentence 3; or (2) an obligation and a negative permission as in sentence 1.

The following example illustrates how a strong "unless" following a deontic "shall" yields a double obligation if clause (5) is the proper negation but not if clause (1) is.

"All shall skate unless"⁷⁷ it rains" is a compound of (a) and either (b) (i) or (b)(2):

(a) if it does not rain, all shall skate

AND

(b)(i) if it rains⁷⁸ all shall (not skate); *i.e.*, it is obligatory that all not skate (no one may skate)

OR

(b)(ii) if it rains all (shall not) skate; *i.e.*, it is not obligatory that all skate - some may (not skate).

A double obligation is produced only if (a) is combined with (b)(i). However, (b)(i) seems not to be a proper negation of "all shall skate" because "it is not the case that all shall skate" seems to mean "all (shall not) skate"; not "all shall (not skate)."⁷⁹ Thus a "strong unless" arguably produces not a double obligation but rather an obligation to skate and permission not to skate, respectively. The proper resolution of this syntactical ambiguity is essential for one who normalizes; one of the two meanings must be stated unequivocally.

F. *Non Truth-Functional Connectives*

When the connectives are truth functional, the truth value of a com-

⁷⁶ This is an "internal" negation. *Id.*

⁷⁷ "Unless" is used in the strong sense.

⁷⁸ "It rains" is a negation of the antecedent of a coimplication. A strong "unless" is by definition a coimplication (sometimes called a biconditional or an equivalence).

⁷⁹ Ross, *supra* note 75, at 154, offers support for this conclusion: "[I]f I ask 'Am I under an obligation to stay at home?' and I get a negative answer, I have received no information at all about what is my duty and especially not the information that it is my duty to go out." According to his discussion of the external deontic negation, "the external negation of a directive is not itself a directive [*i.e.*, is not a negative directive] but is, viewed in isolation, an empty sentence." *Id.* This author agrees with Ross that it is empty of obligation, but not that it is an empty sentence. This conclusion may be illustrated by the following rendition in ordinary English, which reads somewhat awkwardly: "x is not obliged to bring about the social condition p with respect to y" is equivalent to "x is permitted not to bring about the social condition p with respect to y, *i.e.*, NOH (x,p,y) is equivalent to PNH (x,p,y). See Mullock, *Holmes on Contractual Duty*, 33 U. PITT. L. REV. 471, 473 (1972) for an explanation of the notational devise. The latter is empty of obligation, but is a meaningful deontic expression since both obligation and permission are deontic operators. See Anderson, *The Logic of Hohfeldian Propositions*, 12 LOGIQUE ET ANALYSE 231 (1970), reprinted in 33 U. PITT. L. REV. 29 (1971).

pound statement can be computed from the truth value of its constituent sentences. For example, the truth value of not p (Np) depends upon that of p. (P or q) has a truth value which depends upon the truth value of p and the truth value of q. Some connectives, however, called "modals," are not truth functional. For example, the sentence, "it is possible that it is raining," is made up of the simple sentence, "it is raining," coupled with the one-place connective, "it is possible that." The possibility of rain is obviously independent of the truth value of the sentence, "it is raining." The fact that some connectives are not "truth functional" poses problems for the designer of a data base.

LAWGICAL determines a legal consequence, once the user has supplied the computer with the truth value of constituent sentences, because the computer has the ability to determine the truth value of a compound statement from the truth value of a simple statement. Such a determination is essential since the computer is programmed to arrive at a certain legal consequence if a given truth-functional compound statement evaluates as true, and a different legal consequence if it evaluates as false. These principles can be applied to modals in some, but not all, cases. If the statement Lp (it is necessary that p) is joined disjunctively with Lq , a truth-functional compound expression, " Lp or Lq ," can be created if the two modal expressions Lp and Lq are treated as a constituent sentence. However, although " Lp or Lq " may be so treated, $L(p$ or $q)$ may not. For example, consider this problem involving the rule against perpetuities.

A grant "O to A and his heirs so long as gravel is mined at the pit, then to B (a person alive at the time the gift becomes effective) provided B survives until mining ceases," creates an interest in B which will neither necessarily vest nor necessarily fail within his lifetime. However, it will necessarily *either* vest within B's lifetime *or fail* when B dies. If p equals "it vests," and q equals "it fails," " Lp or Lq " is false but $L(p$ or $q)$ is true.⁸⁰ Since $L(p$ or $q)$ is true, the "rule" is not violated. Possible candidates for the constituent sentences of $L(p$ or $q)$ are obviously (1) (p and q) and (2) (Lp and Lq), either of which creates difficulties. The truth value of a truth-functional compound statement is a function of the truth value of the constituent sentences. However, the truth value of $L(p$ or $q)$ is not a function of the truth value of Lp , of Lq or of both (both are false). Nor is it a function of the truth value of p or of q or of both. In fact, at the point in time at which the validity of the gift must be determined, the truth value of these propositions cannot be determined.

What then are its constituents? As I understand normalization, a constituent sentence is one which can be joined with other sentences by the

⁸⁰ This is another example of the importance of distribution, discussed above in relation to the one-place connective "not."

use of logical operators. Thus there is no problem if p and q are treated as the constituent sentences and L and "or" are considered logical operators. But the truth value of the compound statement $L(p \text{ or } q)$ cannot be determined from the truth value of p and q . " $L(p \text{ or } q)$ " is composed of p and q , which join as constituent sentences to form the truth-functional compound sentence " $p \text{ or } q$." $L(p \text{ or } q)$ is created by adding the one place connective " L ," not to an atomic (constituent) sentence but to the compound sentence, " $p \text{ or } q$." Query, is " $p \text{ or } q$ " a constituent sentence when so used? The answer is yes, if a constituent sentence is one which combines with a connective to yield another sentence, *and* if a constituent sentence is one (whether simple or compound) which joins with any connective (whether truth-functional or not) to form a new sentence. We have so defined constituent sentences in the LAWGICAL data base.

IV. LAWGICAL AND THE LAW:

SOME THEORETICAL PROGRAMMING DIFFICULTIES

A. *Universal Generalization*

One of the recurring problems confronting students of the doctrine of *stare decisis* is the logical problem of generating a general normative statement from a specific descriptive statement.⁸¹ A descriptive-historical statement that " j did A " (A_j), and that "the court imposed a sanction" (V_j)⁸² does generate a rule, but only by the application of some drastic logical surgery.

$(x) (Ax \rightarrow Vx) [(for \text{ every } x) (if \text{ } x \text{ has the property } A \text{ then } x \text{ has the property } V)]$ is the full statement of a rule generated from the historic facts A_j and V_j . The journey from " A_j and V_j " to " $(x) (Ax \rightarrow Vx)$ " involves the insertion of a logical operator and application of the principle of Universal Generalization (U.G.).⁸³ The insertion of the operator plus U.G. yields

⁸¹ Stoljar, *The Logical Status of a Legal Principle* 20 U. CHI. L. REV. 181, 188 (1953). See also, F. COHEN, *ETHICAL SYSTEMS AND LEGAL IDEALS* 34, n. 478, who states: "The periodic attempts of students of the common law to put forward logical formulae for discovering 'the rule of a case' all betray an elementary ignorance of the logical fact that no particular proposition can imply a general proposition."

⁸² The j is treated as a constant standing for a particular "legal person" throughout this paper. A = performs a specific act; V = has committed a violation for which a sanction may be imposed.

⁸³ Universal generalization may be used only if j is a "quasi-name" or stands for "any individual whatever." Since j is a constant, universal generalization, as usually applied, may not be used. The insertion of the logical operation is justified by the legal system. If something happens (A_j) and the law imposes a sanction (V_z), then the system supplies the operator. The operator, when added to V_z and V_j , produces $A_j \rightarrow V_j$, hardly a rule of law without U.G. However, because of the legal principle that all legal subjects must be treated alike, U.G. is permissible. It is validated not by any rule of predicate logic alone but by the legal system. Predicate logic allows U.G. if " j " is any arbitrarily selected individual. The law provides that if " j " is treated in a certain way, any arbitrarily selected individual must be so treated.

either $[(x) (Ax \rightarrow Vx)]$ or $[(x) (Ax \leftrightarrow Vx)]$.⁸⁴ The rule under consideration may thus be broken down into two components: (1) a propositional function, either $(Ax \rightarrow Vx)$ or $(Ax \leftrightarrow Vx)$; and (2) universal quantifier ranging over each of them. U.G. transforms a propositional function into a proposition. Rules of laws are frequently stated as propositional functions. Thus $(x) (Ax \rightarrow Vx)$ is often expressed elliptically as " $Ax \rightarrow Vx$." Such formulations do no harm so long as one is aware that the universal quantifier is implied; in fact, it would be pedantic, and in some contexts cumbersome, to state a rule in the following form: *For every person*, if the person is a bona fide purchaser then the person takes free of adverse claims.

Since rules must be universal, it would be redundant to express the universal quantifier in the case of every rule. This analysis applies not only to rules derived by "normative induction"⁸⁵ but also to statutory rules. Generally, statutory rules are stated in the form of propositional functions. Thus, one cannot reason from them to legal conclusions without using U.G. For example, from the propositional function, " $Ax \rightarrow Vx$," and the premise, Aj , there is no logical procedure for deriving " Vj ." However, addition of the universal quantifier makes the following procedure available:

- | | |
|------------------------------|----------------------------------------|
| 1) $Ax \rightarrow Vx$ | Hypothesis |
| 2) $(x) (Ax \rightarrow Vx)$ | Universal Generalization ⁸⁶ |
| 3) $Aj \rightarrow Vj$ | Universal Instantiation |
| 4) Aj | Hypothesis |
| 5) Vj | Modus Ponens |

⁸⁴ Whether this relation is material implication or a stronger one will not be addressed. The difficulty with treating legal implications as material implications is that paradoxes may result. For example, (I) if p is false, then p implies anything (represented by q), (II) if q is true, everything (represented by p) implies p . This can be proven easily as follows:

	PROPOSITION	JUSTIFICATION
(I)	[1] not p	hypothetical
	[2] (not p) or q	addition
	[3] $p \rightarrow q$	df. of material implication
(II)	[1] q	hypothetical
	[2] q or not p	addition
	[3] (not p) or q	commutation
	[4] $p \rightarrow q$	df. of material implication

However, it is believed that the paradoxes of material implication can be avoided. See text accompanying note 105 *infra* for a discussion of "entailment."

⁸⁵ See Stoljar, *supra* note 81, at 184-187, for a discussion of normative induction.

⁸⁶ X stands for "any legal person." That is why rules stated in the form of propositional functions are actually propositions. " $Ax \rightarrow Vx$ " is universally quantified but the quantifier is dropped since it is implicit in the definition of a rule that " x ," when used in a rule, stands for any arbitrarily selected individual. This quantification is "built in" and U.G. is thus permissible.

When we reason intuitively, from the propositional function " Ax implies Vx " and the proposition " Aj ," that " Vj " is true, we unconsciously follow the more rigorous procedure outlined above. Perhaps one would do well to test that unconscious intuition in all cases, for sometimes the unconscious is not reliable and there is no method available for testing intuitions without reasoning through the logical procedure.

B. *Computer Implications*

The LAWGICAL data base consists of "rules" formulated as propositional functions. It is thus important that both the coder and the user be mindful of the implied universal generalization. For example, a constituent sentence, "some BFPs take free of defects in title," is not a rule.⁸⁷ When quantifiers are *not used* expressly, care must be taken to assure that the assumed quantifier is a universal one, not an existential one.

Given this mental reservation, rules may be stated in the form of propositional functions. Thus, " $(x) (Hx \ \& \ GFx \ \& \ Vx \ \& \ Nx) \ HDCx$ " may be stated " Hx and GFx and Vx and Nx implies $HDCx$." If this "rule" were in the LAWGICAL data base and the user wished to know whether $HDCj$ (j is a constant) is true, he would be asked to give the truth value of the following propositions:

- 1) Hx
- 2) GFx
- 3) Vx
- 4) Nx

If he assigns a true value to each of the above, the system will calculate and display the conclusion that $HDCx$. There are two obvious problems with this inference: (1) Hx , GFx , Vx and Nx do not have truth values. They are not propositions but propositional functions. (2) The result $HDCx$ is not a proposition nor is it the result that the user is testing. He is testing the truth value of $HDCj$. It must be translated into a proposition ($HCDj$) by the user. This is done intuitively and unconsciously and does not seem to present any problem.

The following simple exercise demonstrates the difference between (1) the procedures the user employs in conjunction with the computer; and (2) the procedure that would be used in logic: Assume $(Ax \rightarrow Vx)$ as a statement of "a rule" given the implied assumptions discussed above. Assume the user knows that Aj is true. Symbolic logic employs the following procedure for inferring Vj :

⁸⁷ It is not a rule because it uses the existential quantifier. An inference from such a rule would be invalid. The *invalid* reasoning would proceed as follows: Line 1: Some bona fide purchasers take free of claims. Line 2: John is a bona fide purchaser. Line 3: John takes free of claims.

- | | |
|-----------------------------|-------------------------------------------|
| 1) $Ax \rightarrow Vx$ | Hypothesis |
| 2) Aj | Hypothesis |
| 3) $(x)(Ax \rightarrow Vx)$ | 1, Universal Generalization ⁸⁸ |
| 4) $Aj \rightarrow Vj$ | 3, Universal Instantiation (U.I.) |
| 5) Vj | 2, 4, Modus tolens ⁸⁹ |

The LAWGICAL procedure is different:

- | | |
|------------------------|--------------------------------------------------------------|
| 1) $Ax \rightarrow Vx$ | Hypothesis |
| 2) Aj | Hypothesis |
| 3) Ax ⁹⁰ | |
| 4) Vx | 1, 2, Modus ponens. Conclusion is displayed in general form. |
| 5) Vj ⁹¹ | |

Thus the user, by following carefully detailed instructions, can allow the computer to make the calculations while reserving for himself those tasks which require human intervention.

The assumption that all of the rules stated in the form of a propositional function, which are contained in the LAWGICAL data base, are in fact universally quantified propositions is essential to the validity of the system. We now turn to the issue of the validity of this assumption in the context of concerns about normalization.

C. Predicate Logic

Some tasks which can be performed with predicate logic cannot be performed with propositional logic.⁹² Speaking of this problem, Professor Copi observes that certain logical techniques (basically the techniques of propositional logic) permit us to separate valid from invalid arguments, "roughly characterized as those whose validity depends only upon the ways in which simple statements are truth-functionally combined into compound statements."⁹³ He points out, however, that there are other types of arguments to which the validity criteria of propositional logic do not apply. To discriminate between the valid and the invalid with respect to these arguments, one must

⁸⁸ See note 82, *supra*.

⁸⁹ An enthymeme may be substituted for this proof. Step 3 may be eliminated and Step 4 justified by U.I. U.I. may be applied to Step 1 because of the LAWGICAL convention that x stands for any arbitrarily chosen individual.

⁹⁰ The user knows that " j " has the property A and he wishes to discover what property anything (x) has if it has the property A . Thus, he assigns the value true to Ax and the computer computes Vx .

⁹¹ Once the user is informed that anything (x) has the property V , he infers that " j " has that property by U.I. (Universal Instantiation).

⁹² See PURTILL, *supra* note 71, at 155-56.

⁹³ COPI, *supra* note 37, at 316.

employ predicate logic or quantification theory. The need for predicate logic is not limited to certain types of arguments traditionally addressed by logicians. It is also necessary for certain types of reasoning in law, an area explored by Maggs and deBessonnet who note that:

Our initial attempts convinced us that a language somewhat richer than Allen's was needed for adequate representation of legal rules, and our further research has been aimed at the development of the definition of such a language and of computer programs for processing legal rules written in the language.

The language proposed by Layman Allen essentially is designed to translate legal rules into the simplest form of logical structure, that of the branch of mathematical logics known as the "propositional calculus" or "sentence logic." This is a system of logic which deals with complete clauses or sentences joined to one another by logical connectives. Because it does not attempt to analyze structure below the level of the sentence, it is relatively simply to deal with mathematically.⁹⁴

The authors continue their discussion about the difficulty of expressing legal discourse in propositional form and illustrate one problem of translation into normalized form (sentence logic) by reference to U.C.C. section 2-104, which reads:

"Merchant" means a person who deals in goods of the kind or otherwise by his occupation holds himself out as having knowledge or skill peculiar to the practices or goods involved in the transaction or to whom such knowledge or skill may be attributed by his employment of an agent or broker or other intermediary who by his occupation holds himself out as having such knowledge or skill.

Referring to this section, the authors state:

Attempts to translate this section into sentence logic encounter great difficulties, because the logical connectives—the "or"s—are not found between complete causes, but are embedded within the syntactic structure of the sentence. Two alternatives are available: to move toward one of the more complex and sophisticated forms of mathematical logic—some form of the predicate calculus—or to attempt to transform this complicated section into a number of sentences in the propositional logic. In the long run, probably the former approach is the real solution, because the more powerful system of the predicate calculus could lead to solutions of not only this, but of a number of other problems.⁹⁵

D. *Quantifiers: Existential and Universal*

Both logicians and legal analysts agree that problems exist whose solu-

⁹⁴ Maggs & deBessonnet, *Automated Logical Analysis of Systems of Legal Rules*, 12 JURIMETRICS J. 158, 161 (1972).

⁹⁵ *Id.* at 163.

tion requires the use of the predicate calculus, but this fact does not necessarily make the use of normalized statutory drafts impossible. Normalized statutory drafts may be expressed in terms of the predicate logic by the use of the quantification rules explained by Professor Copi.⁹⁶ The simple statement, "a person is a bona fide purchaser," and the simple statement, "a person takes free of defenses," can be combined into a "sentence-logic statement" by the insertion of the logical operator "implies" (\rightarrow) or the logical operator "coimplies" (\leftrightarrow). That propositional statement can then be converted into a universal statement by the addition of a quantifier: "(For every person) (if the person is a bona fide purchaser, then the person takes free of defenses)." To be sure, parenthesis must be used to make clear that the universal quantifier "for every person" ranges over the entire proposition. This should not prove to be a serious obstacle to a coder of a data base, although it might to a legislator who wished to quantify expressly a statute expressed hypothetically. Quantification can be made explicit without parenthesis, however, for example, by the use of the word "whoever" or of the word "all" when the sentence is stated in categorical form. Even in hypothetical form one can say something like "if any person is a holder in due course such person takes free of personal defenses."

Although the occasional need for predicate logic is no reason for failing to draft in normalized form, the development of a system which can handle the rules of predicate as well as propositional logic does pose serious problems. One attempt to solve the problem with use of propositional logic, set forth earlier in this article, treats the rules in LAWGICAL as implicitly generalized expressions.⁹⁷ Whether all of the power of predicate logic needed for legal analysis can be captured in this matter is a matter which will require further study. However, it can be said at this point that LAWGICAL is capable of drawing legal inferences which cannot be handled in propositional logic but which can be handled in predicate logic given the above techniques.

There is one limitation, however, the assumption that whenever a rule is stated as a propositional function (*i.e.*, if x is a bona fide purchaser x takes free of defenses) x stands for "any arbitrarily selected individual." Whether the assumption is reasonable is a question not of logic but of law. In other words, if one restates a legal rule cast in the form of propositional (sentence) logic more completely by the application of U.G., does one merely make explicit what is already implicit in the rule stated as a propositional function, or does one change or at least distort the rule? If rules by their nature must apply universally, the rule is of course not changed by the application of U.G., but is merely made explicit. However, we occasionally find arguments suggest-

⁹⁶ See COPI, *supra* note 37, at 316-351.

⁹⁷ See text accompanying notes 82-83 *supra*. $Ax \rightarrow Vx$ is a universally quantified statement expressed elliptically (*i.e.*, with the quantification dropped but implicitly retained).

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ing that the existential quantifier (for some x) rather than the universal quantifier (for every x) is the appropriate quantifier. For example, Saltzburg and Redden in their commentary on Rule 104(a) of the Federal Rules of Evidence,⁹⁸ address the question of whether the rule makes hearsay admissible in all "preliminary question hearings":

Too much is made in our view of Rule 104(a)'s provision that in making preliminary determinations of fact, the Court "is not bound by the rules of evidence except those with respect to privilege." Clearly this means that the Court *in many instances* can consider hearsay in making rulings on preliminary questions of fact. But nothing in the Rule suggests that it *always* must do so. In our view this subdivision leaves open the possibility that Courts will continue to do what they have done, which is to make the ruling only on whether a conspirator's statement is admissible on the basis of the independent evidence.⁹⁹

Whatever may be said of this statement in terms of policy or of the proper interpretation of the rule, the argument unquestionably involves the use of an existential rather than a universal quantifier. Even if we agree that the hearsay rule should be applicable at *some* preliminary question hearings under Rule 104(a), use of the existential quantifier still does not seem to be the appropriate vehicle for reaching that result. For one thing, in applying rules, lawyers use deductive logic. To be sure, they employ such simple deductive logic that they do it intuitively, but as suggested above, the correct use of deductive logic is essential to a correct application of the legal rule. Refinements of logic may be ignored in those instances where the intuitive and common sense application of logic invariably yields the appropriate result. However, use of the existential quantifier requires one to depart from intuition, since intuition will produce either no answer or an incorrect one. To the extent that from the premises, (1) some holders in due course take free of claims and (2) John is a holder in due course, a lawyer draws the conclusion that John takes free of claims, the lawyer has engaged in invalid reasoning. The invalidity of this inference is intuitively obvious and, to the extent that it is, resort to more rigorous techniques is unnecessary. However, to the extent that one's inferences may be baffled by more complex problems, one would do well to use the techniques of deductive logic, including predicate logic, to determine what, if any, inferences can be drawn from the rules stated with the use of an existential quantifier. Generally, resort to such logic demonstrates that no useful inference whatever can be drawn. Thus the problem of a rule stated with an existential quantifier (implicit or explicit) is not serious because a rule which does not apply universally is not a rule at all. It would be impossible to apply.¹⁰⁰

⁹⁸ FED. R. EVID. 104(a) reads: "Preliminary questions concerning . . . the admissibility of evidence shall be determined by the court . . . (b), in making its determination it is not bound by the rules of evidence except those with respect to privilege."

⁹⁹ S. SALTZBURG & K. REDDEN, FEDERAL RULES OF EVIDENCE MANUAL 467 (1977).

¹⁰⁰ See Cullison, *The Logic of Legal Rules and Legal Obligation*, 13 CONN. L. REV. 215,

It might be noted that there is another approach to Rule 104(a) which does not involve the impossible task of stating a rule with an existential quantifier. The rule that "the Court is not bound by the Rules of Evidence" could be interpreted to mean that the Court is permitted not to use the Rules of Evidence. Such a statement is not inconsistent with the statement, "the Court is permitted to use the Rules of Evidence." This result can be shown by use of the "square of opposition" for deontic logic in which the statement that the Court is permitted not to use the Rules of Evidence is an "O" proposition and the statement that the Court is permitted to use them is an "I" proposition. I and O propositions in squares of opposition are compatible (*i.e.*, I and O can both be true although they cannot both be false).¹⁰¹ Thus a Court may apply the Rules of Evidence at preliminary hearings without resort to the existential quantifier.

This author's somewhat tentative conclusion is that LAWGICAL, though its data base is written in the *form* of propositional logic, has much of the power of predicate logic. This conclusion would *not* be true if rules could be stated with existential quantifiers, but, even if one assumes that rules so quantified are rules at all (a very dubious assumption), they are too rare to have any serious impact on the utility of LAWGICAL. The reason this assumption is doubtful is that those who reason from rules (almost) always use deductive logic in applying them. This approach is valid if, but only if, U.G. is an implied term. Lawyers reason in enthymemes. The existential quantifier, if used at all, is used when a Court or commentator wishes to escape the application of a rule which is inconsistent with the policy of the drafter. But, whatever construction technique may be used to escape the mechanical application of an unwise rule, the existential quantifier technique (used, *e.g.*, by some commentators on Rule 104(a) of the Federal Rules of Evidence) is not an appropriate vehicle, for it introduces into the legal structure, if not chaos, at least serious problems.

If the assumption is correct that rules of law cast in the "form" of propositional functions are in fact propositions because of an implied universal quantifier, how then do we convert embedded phrases so as to re-

236 (1981), who states: "Most legal rules are general; they apply by their terms to all people, all instruments, or whatever, that have the properties or relationships designated in the rules" (emphasis added). It should be noted that using universal quantifiers exclusively is not incompatible with the notion of judicial discretion. *Id.* at 241. To the extent that a rule stated with an existential quantifier may still be characterized as a rule, it cannot be handled by the present LAWGICAL system. This does not appear to be a serious problem in view of the extreme rarity of existentially quantified "rules," if, in fact, they are not excluded by the very nature of a "rule." It is occasionally asserted that U.G. is inconsistent with the fact that rules have exceptions. This assertion is not correct. Use of the universal quantifier is not inconsistent with exceptions; it makes every member of a class or subclass the subject of a sentence. Thus, one can say, (for every person) (if the person is a taxpayer and the person is over 65, then the person has a certain additional exemption). The relevant class over which the universal quantifier ranges is a subclass of taxpayers.

¹⁰¹ See Finan, *Presumptions and Modal Logic: A Hohfeldian Approach*, 13 AKRON L. REV. 19, 30 (1979).

formulate them in propositional form? Generally it can be done, with a certain amount of imagination and trial and error. Take for example, the rule of U.C.C. section 3-305, "to the extent that a holder is a holder in due course he takes the instrument free from all defenses of any party to the instrument with whom the holder has not dealt."¹⁰² In order to convert this rule to propositional logic, we must convert the prepositional phrase, "with whom the holder has not dealt," into sentence form. The following normalization is suggested:

1. A person is a holder.
2. The holder holds in due course.
3. The holder has not dealt with a certain person.
4. The holder takes the instrument free from defenses of that person.

Those sentences combined by the addition of logical operators, yield the propositional form: if a person is a holder and the holder holds in due course, and the holder has not dealt with a certain person then the holder takes the instrument free from defenses of that person. This suggested normalization could undoubtedly be improved upon, but it illustrates an initial approach to normalization of sentences containing embedded phrases. In the author's experience with normalization, embedded phrases have always proved to be convertible into propositional form.

E. *The Problem of Semantic Range*

One of the chief problems with interpreting law is that of determining the semantic range of terms. Generally LAWGICAL deals merely with syntactic connectives. However, semantic problems as well, although largely left to the user, can be addressed by LAWGICAL.

There are two types of definitions in logic, the denotative¹⁰³ and the connotative.¹⁰⁴ Lawyers distinguish between the two, although they usually employ less formal terminology, sometimes calling denotative definitions "definitions by enumeration" and connotative definitions "class definitions." Denotative definitions are subject to computer programming, whereas connotative definitions pose difficulties currently unresolved. In LAWGICAL the "expansions" frequently contain an enumeration of the elements of the defined term. If the elements are exhaustive, the definition is complete and the logical relation is expressed as a coimplication. If, on the other hand, the enumeration is incomplete, the relation is expressed as an implication. Connotative definitions cannot be handled in such a manner because they involve a *creative* element. Whether a World War II jeep is a vehicle within the mean-

¹⁰² For the purposes of this illustration the exceptions found in § 3-305(2)(a) through (e) will be ignored.

¹⁰³ See *COP*, *supra* note 37, at 129.

¹⁰⁴ *Id.* at 132.

ing of an ordinance forbidding the presence of jeeps in a park is obviously a question whose answer cannot be automated. However, to the extent that legal classifications are determined by enumeration, LAWGICAL can display definitions.

Another type of definition, a partial definition, is occasionally used and it presents difficulties for coders in that it expresses a limitation on semantic range couched in a syntactical form. The range of referents of a particular term to be defined is a function of both inclusion and exclusion. For example, a rule of law might read, "p implies q," and another rule might read, "not (r implies not q)." At first blush, this seems anomalous. If p is a sufficient condition of q, r would seem to be irrelevant. However, if the second rule is seen as a semantic clue to the meaning of p, no difficulty is involved. Basically the second rule is that p is compatible with r (*i.e.*, that whatever the semantic range of p may be, it is not limited by the truth of the proposition r). U.C.C. section 3-105 offers an example. It specifies eight elements which do not limit the semantic range of the word "conditional." It does not provide that any of those elements is a sufficient condition for the conclusion that a promise or order is unconditional. It merely states that one may not draw the inference that, because one of those eight elements is present, an instrument is unconditional. This is valuable semantic information which does not fit easily into the drafting techniques developed for LAWGICAL. Generally, legislators employ this type of drafting when, in repealing a limitation that prevailed under former law, they wish to make it clear that the former limitation does not survive passage of the new act. The official comment to section 3-105, *e.g.*, states, "that a promise or order otherwise unconditional is not made conditional by the fact that the instrument (a) is subject to implied or constructive conditions" was enacted by the legislature "to make it clear that, so far as negotiability is affected, the conditional or unconditional character of the promise or order is to be determined by what is expressed in the instrument itself; and to permit certain specific limitation upon the terms of payment."

Legislators use a similar technique not to indicate that something is compatible with "a" or that it is compatible with "not a," (*i.e.*, partial compatibility) but to indicate that the semantic range is compatible with both "a" and "not a" (*i.e.*, complete compatibility). For example, U.C.C. section 3-417 provides that the warranty against material alteration is not given by holders in due course acting in good faith to certain parties, "even though [whether or not] the acceptance provided 'payable as originally drawn' or equivalent terms." Those who have worked with data bases for LAWGICAL have dealt with drafts which specify either partial or complete compatibility. The data base could be constructed as follows: Complete compatibility may be inserted into a rule by a use of a tautology. For example, if the rule states "p implies q whether or not t," (*i.e.*, complete com-

patibility) it may be formulated: p and $(t \text{ or not } t)$ implies q . Partial compatibility, p implies q even if t , may be expressed tautologically, $((p \text{ or } (p \& t)) \text{ implies } q)$.

Apart from the charge of redundancy, the above formulation involves another programming difficulty. Most programs, in order to compute a legal consequence, require the user to enter the truth value of each and every sentence. If one does not know the truth value of the extra component of the tautology sentence, one cannot enter it and it follows that the computer cannot convey the information that the truth value is irrelevant. Happily this problem does not interfere with the workings of LAWGICAL, for in LAWGICAL, the computer eliminates irrelevancies whether or not it is supplied the truth value of the simple sentence whose truth value is irrelevant to the computation of a legal consequence. As for redundancy, that need not be a serious problem. Generally the coder of a LAWGICAL data base drafts atomic sentences and expresses the logical relationships symbolically. The user does not see the symbolic representation and so is not distracted by the tautology which is apparent only to one who sees the program. Thus in LAWGICAL, the tautological response to the compatibility and partial compatibility problem may be appropriate since, in LAWGICAL, the user can supply three pieces of information: (1) A certain sentence is true; (2) the sentence is false; (3) I don't know. Since the legal consequence computed for the user is unaffected by which of the three choices he selects, the tautological approach seems to be a happy solution of the compatibility problem although it will not work in systems whose program demands that some truth value be assigned to each and every sentence. The user of LAWGICAL can enter three types of information: namely, p is true, p is false, and I don't know. Given the structure of the system, the user supplies the third item of information simply by not making any entry with respect to a particular sentence whose truth value is unknown. LAWGICAL's capacity to factor into its calculations the "non-entry" of the truth value of certain sentences gives the user a great deal of aid which would not otherwise be available.

F. *The Paradoxes of Material Implication*

The paradoxes of material implication¹⁰⁵ are a function of two rules, "anything at all materially implies a true proposition,"¹⁰⁶ and "a false proposition materially implies anything at all,"¹⁰⁷ where q stands for any proposition whatever. The problems of material implication can arise when the "if then"-relationship is defined in terms of truth tables, as it is in the APL systems program. Experience has shown that using systems programs to compute the truth value of truth-functional compound statements where the con-

¹⁰⁵ See COP1, *supra* note 37, at 283.

¹⁰⁶ See Cullison, *supra* note 100, at 235; see also *supra* note 84.

¹⁰⁷ *Id.*

nectives are "and," "or" and "not" does not create difficulty with paradoxes. It seems, therefore, that since the paradoxes appear only with respect to implications and coimplications, they can be avoided by care in stating the relations to be entered in the data base. The systems program is used only to compute the truth value of compound sentences formed by the connectives "and," "or" and "not," and the coder gives direction with respect to "if then" and "if and only if then" relations. Experience, at least so far, indicates that, so long as that procedure is followed, the mischief created by paradoxes will not creep into the system and invalidate deductive inferences computed by LAWGICAL.

Cullison suggests three ways of dealing with the problem of the paradox of material implication. One way is, "simply to ignore it. It's really not all that much of a problem since the extra implications that might creep into our reasoning will never lead us to a wrong conclusion."¹⁰⁸ A second way of dealing with the problem is, "to sidestep it and avoid using material implication altogether."¹⁰⁹ Cullison's third suggested way of dealing with the problem is "to develop a logic system with a concept that comes closer to the intuitive concept of implication [*i.e.*, necessary implication]."¹¹⁰ He states that, "the cure is to use a different kind of implication that requires that its consequent depend on its antecedent,"¹¹¹ and continues, "the point here is to permit the inference Twv (w entails v) only when v depends on w , which is to say when w is used in deriving v ."¹¹² In describing the system of entailment called system E, Cullison states, "we're interested in system E only because it allows us to derive and express implications that aren't counterintuitive."¹¹³ LAWGICAL seems to meet these criteria. After all, a logical system is not designed to train lawyers how to think, but rather to capture and replicate the way they think already. Material implication has features which clearly do not capture how lawyers think, and entailment is clearly more faithful to legal reasoning. LAWGICAL does not expose the user to errors generated by paradoxes. As pointed out by Dr. Welch, "If the expression [the antecedent] evaluates as false, no assignment can be made to the conclusion. A message is displayed that the implication has failed."¹¹⁴ One need not fear, with LAWGICAL, that an assignment of the value false to an antecedent will produce a paradoxical result. LAWGICAL assigns the value true only when an antecedent evaluates as true. It assigns the value false or makes no assignment when the antecedent evaluates as false.

¹⁰⁸ Cullison, *supra* note 100, at 235.

¹⁰⁹ *Id.*

¹¹⁰ *Id.* at 236.

¹¹¹ *Id.* at 257. See also THE HARPER DICTIONARY OF MODERN THOUGHT 206 (1977) for the definition of "entailment."

¹¹² See Cullison, *supra* note 100, at 258.

¹¹³ *Id.* at 259.

¹¹⁴ Welch, *supra* note 70, at

The second paradox, that a true proposition is implied by anything, cannot occur in LAWGICAL. A consequent is assigned the value true if and only if the antecedent is assigned the value true. LAWGICAL seems to capture those features of entailment (E) which, according to Cullison, free us from the danger of paradoxical results.¹¹⁵

V. CONCLUSION

LAWGICAL appears to avoid the paradoxes of material implication and to give at least some of the power gathered from quantification theory. There is no question, however, that additional work needs to be done. As Cullison points out, ordinary propositional logic is inappropriate for certain problems: "it's a wardrobe of two-armed shirts. A legal rule should be represented as a proposition of *deontic* logic, the logic of obligation."¹¹⁶ This statement is probably true,¹¹⁷ but not all agree; it has been suggested that the truth functions of law, like those of logic, are alethic and not deontic.¹¹⁸ This writer has taken a middle position asserting that duty and its derivatives are deontic, while power and its derivatives are alethic.¹¹⁹

Work continues on these problems. It seems unlikely that any system of logic which exactly reflects the nature of lawyers' reasoning will be discovered in the near future, if ever. And, to the extent that logics are discovered that more accurately reflect legal discourse than those currently in use, there will be the further difficulty of coding computers to replicate these logics. As of this writing, however, it may be said with a fair degree of confidence that systems such as LAWGICAL are a promising beginning.

¹¹⁵ For a complete discussion of entailment, see A. ANDERSON & N. BELNAP, *ENTAILMENT* (1975). See also Allen, *Formalizing Hohfeldian Analyses to Clarify the Multiple Senses of Legal Writing: A Powerful End for the Electronic Age*, 48 S. CAL. L. REV. 428 (1974); CHELLAS, *supra* note 30.

¹¹⁶ Cullison, *supra* note 100, at 240-41.

¹¹⁷ See e.g., Anderson, *supra* note 79; Finan, *supra* note 101; Mullock, *supra* note 79.

¹¹⁸ See Stone-de Montpensier, *The Compleat Wrangler*, 50 MINN. L. REV. 1001, 1006 (1966).

¹¹⁹ See Finan, *supra* note 100. There is also a close nexus between them. See Anderson, *A Reduction of Deontic Logic to Alethic Modal Logic*, 67 MIND 100 (1958).

