A Logic for Statutes

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by

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Abstract

Case-based reasoning is, without question, a puzzle. When students are taught to "think like lawyers" in their first year of law school, they are taught case-based common-law reasoning. Books on legal reasoning are devoted almost entirely to the topic. How do courts reason from one case to the next? Is case-based reasoning reasoning from analogy? How should case-based reasoning be modeled? How can it be justified?

    In contrast, rule-based legal reasoning (as exemplified in much statutory reasoning) is taken as simple in legal scholarship. Statutory interpretation—how to determine the meaning of words in a statute, the relevance of the lawmakers' intent, and so forth—is much discussed, but there is little treatment of the structure of statutory reasoning once the meaning of the words is established. Once the meaning of terms is established, statutory reasoning is considered, roughly speaking, to be deductive reasoning.

This Essay examines the structure of statutory reasoning after ambiguities are resolved and the meaning of the statute's terms established. It argues that standard formal logic is not the best approach for modeling statutory rule-based reasoning. Rather, the Essay argues, using the Internal Revenue Code and accompanying regulations, judicial decisions, and rulings as its primary example, that at least some statutory reasoning is best characterized as defeasible reasoning—reasoning that may result in conclusions that can be defeated by subsequent information—and is best modeled using default logic. The Essay then addresses the practical and theoretical benefits of this alternative understanding of rule-based legal reasoning.

I. Introduction

Common law reasoning is, without question, a puzzle. When students are taught to "think like lawyers" in their first year of law school, they are taught case-based, common law reasoning. Books on legal reasoning—and there are many—are devoted almost entirely to case-based reasoning. Is case-based reasoning reasoning from analogy? How should such reasoning be modeled? How can it be justified?

Rule-based legal reasoning, as exemplified by statutory reasoning, is in contrast taken as simple in legal scholarship. Statutory *interpretation*—how to determine the meaning of words in a statute, the relevance of the lawmakers' intent, and so forth—is much discussed, but there is little treatment of the structure of statutory reasoning once the meaning of the words is established. For example, in a leading book on legal reasoning, the chapter entitled "Interpreting Statutes and Other Posited Rules" addresses only the problems of interpreting the lawmakers'

intended meaning.[1] The actual reasoning underlying statutory analysis is disposed of in just two pages: statutory reasoning simply involves following rules. Statutory reasoning is difficult only to the extent that understanding a term in the statute is difficult, and the meaning of the term, they explain, will be determined by a court, which throws us right back into common law reasoning. The classic text *An Introduction to Legal Reasoning*[2] deals with statutory reasoning in a similarly cursory fashion: statutory reasoning is often considered deductive, the book explains, and, while this may not be true, it is a useful approach; any complications that arise come from "ambiguity in the words used."[3]

This Essay examines the structure of rule-based reasoning after ambiguities are resolved and the meaning of the rule's terms established. For rule-based legal reasoning is not best understood as merely deductive. And while rule-based reasoning can be fruitfully modeled using formal logic, standard formal logic is not the best approach for modeling rule-based legal reasoning. Rather, this Essay argues, using the Internal Revenue Code and accompanying regulations, judicial decisions, and rulings as its primary example, that at least some rule-based legal reasoning is best characterized as *defeasible reasoning*— reasoning that may result in conclusions that can be defeated by subsequent information—and is best modeled using a nonstandard logic called *default logic*. Default logic, unlike standard logic, directly represents defeasible reasoning: default logic permits formal reasoning that results in conclusions that may later be defeated.

Default logic is superior to standard logic for representing certain statutory reasoning because, as the Essay explains, default logic makes explicit otherwise implicit reasoning and decisions about rule priority, decisions that are required to follow statutes and other legal rules. Default logic also captures the structure of legal rules, which standard logic entirely fails to do, and it more accurately reflects rule-based legal reasoning as actually practiced by lawyers, judges, and legislative drafters.

Moreover, because default logic permits a more accurate representation of rule-based legal reasoning, there are a number of theoretical

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1. Larry Alexander & Emily Sherwin, Demystifying Legal Reasoning 131–66 (2008).

2. Edward H. Levi, An Introduction to Legal Reasoning (Univ. of Chi. Press 2013) (1949).

3. *Id.* at 28.

and practical advantages to using default logic, as opposed to standard logic, to model such reasoning. First, using default logic to model rule-based legal reasoning highlights the importance of and permits theorizing about rule priority. Second, because default logic captures the actual structure of the law, default logic makes it easier to translate (legal) code into (computer) code, which is particularly important given the growing use of artificial intelligence in legal practice, whether for e-discovery or for searching for the structure (as opposed to substance) of arguments that have been particularly effective. And, finally, because default logic allows legislative drafters to formalize their actual practice, drafters who use default logic will find it simpler to detect errors and ambiguities in legislation.

A range of literature argues that legal reasoning is best understood as defeasible reasoning.[4] Indeed, the word "defeasibility" is borrowed from the law.[5] Yet these sources generally (though not entirely) neglect the intrinsic defeasibility of rule-based legal reasoning. Hage, for example, argues that legal reasoning may be defeasible, but his reasons for defeasibility include only that the burden of proof or the process of discovery may introduce new information, and that extralegal considerations may include implied exceptions to the law.[6] Vernon Walker argues for the application of default logic to the law but limits his discussion to reasoning about evidence (fact-finding).[7] There are a few examples of defeasible rule-based reasoning in the literature. John Horty, for example, provides a fictional example of a conflict between a federal and a state statute to illustrate default reasoning.[8] This Essay takes a similar approach, but instead of using a fictional example, it draws from an actual statute and demonstrates defeasibility intrinsic to the statute itself.

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4. *E.g.*, Jaap Hage, *Law and Defeasibility*, 11 Artificial Intelligence & L. 221 (2003); Henry Prakken & Giovanni Sartor, *The Three Faces of Defeasibility in the Law*, 17 Ratio Juris 118 (2004); Giovanni Sartor, *A Formal Model of Legal Argumentation*, 7 Ratio Juris 177 (1994); Giovanni Sartor, *Normative Conflicts in Legal Reasoning*, 1 Artificial Intelligence & L. 209 (1992).

5. The term dates back to at least H.L.A. Hart, *The Ascription of Responsibility and Rights*, 49 Proc. Aristotelian Soc'y 171 (1948).

6. Hage, *supra* note 4.

7. Vern R. Walker, *A Default-Logic Paradigm for Legal Fact-Finding*, 47 Jurimetrics 193 (2007).

8. John F. Horty, Reasons as Defaults 120–21 (2012).

II. DEFEASIBLE REASONING AND DEFAULT LOGIC

Once deductive reasoning provides a conclusion, nothing within deductive reasoning can unseat that conclusion. Consider a very basic deductive argument: "If A, then B. We know that A. Therefore, B." Given A, no additional information can shake the reasoner from B. (Of course, changing the information one has can change the conclusion. "I thought that if A, then B. But I was wrong. So although I have A, I cannot conclude B.") Because conclusions arrived at through deductive reasoning cannot be defeated by additional information, such conclusions are *indefeasible.*

Most everyday reasoning, in contrast, leads to defeasible conclusions, conclusions that might be defeated by additional information. (Defeasible reasoning is sometimes referred to as the logic of jumping to conclusions.) In the classic example, someone learns that Tweety is a bird and concludes that Tweety can fly. But this conclusion is defeasible, because additional information could cause the reasoner to change his mind. For example, if the reasoner learns that Tweety is a penguin, he will conclude that Tweety can't in fact fly.

Because deductive logic is indefeasible—regardless of additional information, a conclusion, once reached, will not be rejected—the formalization of deductive logic ("standard logic") is monotonic: once a conclusion is accepted, it cannot be rejected. In contrast, formalized defeasible logic is nonmonotonic: additional information can cause the reasoner to reject an earlier conclusion.

There are a variety of ways to formalize nonmonotonic reasoning. This Essay uses a variant of *default logic.*[9] Under this approach, the reasoner has a set of propositional formulas, *W*, which we can informally think of as a world of facts; default rules (each default rule δ, and the set of default rules *D*); and a relationship between the default rules (<). We can call the collection of the set of facts, default rules, and relationship between the rules $\Delta = (W, D, <)$. The relationship between the default rules establishes the relative priority of the default rules—which rule takes precedence over another—and thus this approach is a type of *prioritized* default logic.

For example, consider trying to determine whether a particular person—call him Henry—can read. If the only information you have is that Henry lives in the United States (*UnitedStates*), you should conclude

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9.   Default logic was originally developed in R. Reiter, *A Logic for Default Reasoning*, 13 ARTIFICIAL INTELLIGENCE 81 (1980).

that he can read (*Read*).[10] If you learn, however, that Henry is five years old, you should conclude he cannot read, as most children in the United States do not read before age six (*Young* for younger than age six). These two rules together give us our set Δ of default rules, rules that might be defeated by each other or by other rules. These rules don't apply with certainty, but in general they are good guides to reasoning.

More formally, if we know that Henry lives in the United States and Henry is five years old, we have $\Delta = (W, D, <)$, where

W = {UnitedStates, Young}

$D = \{\delta_1, \delta_2\}$

δ_2: UnitedStates → Read

δ_1: Young → ¬Read

$<: \delta_1 < \delta_2$.

The "lower" the rule, the stronger, so here, δ_1 dominates δ_2. That is, if both might apply, δ_1 "beats" δ_2.

Given *W*, we reason as follows. First, accept everything in our world—*W*—and everything that we can prove (using regular, monotonic, standard logic) from that world. The only thing we can prove from our world and nothing else is *UnitedStates* and *Young*—i.e., that Henry lives in the United States and is young.

Second, take the most dominant rule—here, δ_1: *Young* → ¬*Read*, that is, if a person is young, then in general he cannot read. (Notice that this is the most specific rule as well.) Adding δ_1: *Young* → ¬*Read* to what we believe won't create any contradictions, as all we believe is *UnitedStates* and *Young*. So we add δ_1 to the things we believe, along with everything else we can derive from *W* along with δ_1. We now believe that Henry can't read—¬*Read*—because from *Young* and *Young* → ¬*Read* we can derive ¬*Read*.

We then move to the next-most-dominant rule—here, δ_2: *UnitedStates* → *Read*. This rule is inconsistent with what we already believe. If we were to add this rule to what we already believe, we'd be able to

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10. Approximately 99% of the U.S. population older than 14 can read, CENTRAL INTELLIGENCE AGENCY, THE WORLD FACTBOOK (2016), and 80% of the U.S. population is older than 14, U.S. CENSUS BUREAU, 2010 CENSUS BRIEFS: AGE AND SEX COMPOSITION 4 (2011).

derive both *Read* (because we already believe *UnitedStates*) and ¬*Read* (because we already believe *Young* and *Young* → ¬*Read*). So we don't add δ_2 to what we believe.

There are no more rules to check, so we are done. We should now believe everything we can derive from *W* together *with δ_1: Young* → ¬*Read*, so we should believe that Henry can't read.

A legal example helps show why this approach to formalizing defeasible reasoning captures rule-based legal reasoning well.

III. Using Default Logic To Formalize the Law: An Example

This Essay focuses on section 163(h) of the Code, the statute that permits the home mortgage interest deduction. There is nothing unusual about this section, but it is a useful statute on which to focus because it is both a complex section, permitting explication of a range of concerns, and yet also fairly brief. This Part first describes the law for the year 2017 contained in section 163(h), and then provides a formalization of that law.

A. The Law: Section 163

In general, interest payments are deductible.[11] Deductions reduce income subject to tax. For example, if a company borrows $10,000 from a bank at an interest rate of, say, 8% per year, payable annually, the annual payments of $800 will reduce the company's income that is subject to tax. If the company is subject to tax at a rate of 35% (the highest corporate tax rate), all else equal, the deduction will reduce its tax by $280 (that is, by 35% of $800). Assume, for example, that the company has, taking into account all other income and deductions but not taking into account the interest deduction, taxable income of $1,000. It owes tax of $350 (35% of $1,000). But taking into account the deduction, the company will have taxable income of $200 (that is, $1,000 minus $800), and thus will owe tax of only $70 (35% of $200).

However, personal interest payments are in general not deductible.[12] "Personal interest payments" are defined by exclusion: all payments are personal interest payments except six discrete items, which include (roughly speaking) interest on debts that were incurred for business purposes and, most importantly for our purposes, "qualified

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11. I.R.C. § 163(a).
12. I.R.C. § 163(h)(1).

residence interest,"[13] commonly known as the "home mortgage interest deduction."

Qualified residence interest is defined as interest accrued on either "acquisition indebtedness" or "home equity indebtedness," both with regard to a "qualified residence" of the taxpayer.[14] A "qualified residence" includes both the taxpayer's principal residence and one other residence of the taxpayer for which the taxpayer makes an election to count it as a qualified residence.[15] Thus the home mortgage interest deduction is available with respect to interest paid on debt related to up to two homes.

Acquisition indebtedness is debt that is incurred in acquiring, constructing, or substantially improving a qualified residence, and that is secured by such residence.[16] (Debt is "secured" by a residence if the lender has recourse to the residence if the borrower fails to pay the debt.) The maximum amount that can be treated as acquisition indebtedness for a given year is $1 million.[17] For example, imagine Benny, a taxpayer who buys a $1.6 million home. He pays $500,000 cash and takes out a $1.1 million purchase money mortgage. That is, he borrows $1.1 million from the bank and uses that to buy the house. If Benny does not pay the debt, the lender can foreclose on the house and sell it in order to pay the balance of the debt. Therefore, the mortgage is secured by the house. The interest rate on the debt is 7%, accruing and payable annually, so the taxpayer owes $77,000 of interest per year.

The general rule says that interest is deductible. But a more specific rule says that personal interest is not deductible. Benny's interest does seem to be personal in an informal sense (because he uses it for the personal purpose of buying a house), but the statute defines personal interest as not including, *inter alia*, interest paid on acquisition indebtedness up to $1 million. The $1.1 million mortgage was used to acquire a home that is Benny's principal residence, and it is secured by that home, so a portion of the debt is acquisition indebtedness. Specifically, the interest on $1 million is deductible with respect to acquisition indebtedness. But the $77,000 represents interest on $1.1 million. With respect to acquisition indebtedness, Benny may deduct only the amount that

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13.   I.R.C. § 163(h)(2)(D).
14.   I.R.C. § 163(h)(3)(A).
15.   I.R.C. § 163(h)(4)(A).
16.   I.R.C. § 163(h)(3)(B)(i).
17.   I.R.C. § 163(h)(3)(B)(ii).

bears the same relation to $77,000 that $1 million bears to $1.1 million. Therefore, with respect to acquisition indebtedness, Benny may deduct $70,000:

$$\frac{Deductible}{\$77,000} = \frac{\$1,000,000}{\$1,100,000}$$

Therefore, *Deductible* = $70,000.

Thus Benny's income subject to tax is reduced, all else equal, by $70,000, which provides Benny a benefit, the value of which depends on his tax rate. If Benny is in the highest tax bracket, for example, he will save $25,830 (39.6% of $70,000) on his taxes due to the deduction.[18]

Home equity indebtedness is debt that is secured by a qualified residence, to the extent that the debt does not exceed the fair market value of the qualified residence, reduced by the amount of acquisition indebtedness with respect to that residence.[19] The total amount treated as home equity indebtedness cannot exceed $100,000.[20] For example, take a taxpayer in the highest tax bracket who purchases her principal residence for $700,000, using only debt secured by the house. By assumption, the debt is acquisition indebtedness, and she pays 5% annual interest on the debt. Each year, therefore, she may deduct $35,000 with respect to the debt, thus reducing her tax owed by $13,860 (39.6% of $35,000).

Some time passes, and the value of her house increases to $800,000. She has paid down none of the principal on the first loan. Another lender now lends her $100,000 secured by the house. (To see why the second lender is willing to lend her $100,000, think about what happens if the taxpayer defaults on her debt. The debt is secured by the house, so the house will be seized and sold and the funds distributed to the lenders. The first $700,000 will go to pay the first lender, but there will still be $100,000 left to pay the second lender.) This second $100,000 is home equity indebtedness, because it is secured by the home and does not exceed the fair market value of the qualified residence ($800,000) reduced by the acquisition indebtedness ($700,000). If she had borrowed $150,000 instead, she would still be able to deduct only the interest with

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18. Interest on the remaining $100,000 may also be deductible, of course; this portion of the example addresses only the interest due to the acquisition indebtedness.

19. I.R.C. § 163(h)(3)(C)(i).

20. I.R.C. § 163(h)(3)(C)(ii).

respect to the $100,000 difference between the fair market value and the acquisition indebtedness.[21]

B. Section 163 Formalized

I turn now to formalizing the law just described. As described above, the relevant law provides three main rules with regard to the deductibility of interest.

First, in general, interest payments (*Interest*) are deductible (*Deductible*):

δ_3: Interest → Deductible.

Second, even though in general interest payments are deductible, personal interest payments (*Personal*) are in general not deductible:

δ_2: Personal → ¬Deductible.

And, finally, even though personal interest payments are in general not deductible, if the personal interest payments are payments of qualified residence interest (*QRI*), then those payments are deductible:

δ_1: QRI → Deductible.[22]

It may seem that δ_1 does not track the Code. According to the Code, "personal" interest does not include, inter alia, qualified residence interest. So the Code embeds the exception for qualified residence interest within the definition of personal interest. But, notwithstanding the language of the Code, qualified residence interest is conceptually an exception to the rule that personal interest is not deductible. This is how court opinions, treatises, and the legislative history characterize the rule,

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21.   Why would a lender lend more than the difference between the fair market value and the acquisition indebtedness? Perhaps the lender thinks that the fair market value is incorrect and in fact the house is, or will be, worth more. Or perhaps the lender will not bear the risk of default because it plans to resell the debt quickly. For an illustration, consider the market collapse of 2007–2008.

22.   Even though no rule within Code section 163 suggests that this rule is defeasible, it is defeasible, because other rules in the Code may defeat it.

even as they accurately reflect its placement in the Code. I provide a few examples below, selected almost at random from the relevant pool of sources; each of these examples could be multiplied.

In *Pau v. Commissioner*, the Tax Court states, "Section 163(h) disallows personal interest deductions unless they fit within certain narrowly prescribed categories. Among these narrow exceptions is the deduction for interest on a qualified residence."[23] Of course, by the language of the Code, section 163(h) simply disallows what it defines as personal interest deductions, and deductions for interest on a qualified residence is not a personal interest deduction. But notwithstanding the structure of the Code, the court reads the home mortgage interest deduction as an exception to the personal interest rule. Similarly, a leading federal income taxation treatise explains that personal interest is generally nondeductible, then notes "[Congress] qualified § 163(h) with a broad exception for home mortgages."[24] Again, strictly speaking, from the structure of the Code, personal interest is nondeductible, and personal interest does not include qualified residence interest.

The history of current section 163(h) also reflects the home mortgage interest deduction as an exception from the general rule that personal interest is not deductible. In the tax reform proposal that limited personal interest deductions, the change in law was described as limiting the deduction of "all interest not incurred in connection with a trade or business (other than interest on debt secured by the taxpayer's principal residence . . .)."[25]

Additionally, order the rules, defining

$$<: \delta_1 < \delta_2 < \delta_3.$$

That is, δ_1 dominates δ_2, which dominates δ_3.

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23.   T.C. Memo 1997-43, 1997 WL 28678, at *12.

24.   Boris I. Bittker & Lawrence Lokken, Federal Taxation of Income, Estates and Gifts ¶ 31.1 (2017).

25.   Ronald Reagan, The President's Tax Proposals to Congress for Fairness, Growth, and Simplicity 323 (1985). For a general discussion of the history of the mortgage interest deduction that clearly reflects that the deduction is an exception to the general rule that personal interest is not deductible, see Dennis J. Ventry, Jr., *The Accidental Deduction: A History and Critique of the Tax Subsidy for Mortgage Interest*, 73 L. & Contemp. Problems 233 (2010).

There are also two rules that are certain (essentially, they are definitional) and thus go in W (additional information may also go in W): personal interest payments are always interest payments, and qualified residence interest payments are always personal:

Personal $\rightarrow$ Interest

QRI $\rightarrow$ Personal.

Thus:

W = {Personal $\rightarrow$ Interest, QRI $\rightarrow$ Personal}

δ_3: Interest $\rightarrow$ Deductible

δ_2: Personal $\rightarrow$ ¬Deductible

δ_1: QRI $\rightarrow$ Deductible

<: $\delta_1 < \delta_2 < \delta_3$.

This $\delta = (W, D, <)$ shows the general structure of the system of rules. Formally defining these terms adds a level of complication, but at heart, these rules provide the structure of section 163(h). (One might argue that there are four relevant rules, and that one should consider that in general, payments are not deductible—that is, without an explicit statutory authorization, no deduction may be taken; thus, add *Interest $\rightarrow$ Payment* to W, and δ_0: *Payment $\rightarrow$ ¬Deductible* to D. But for our purposes, these three suffice.)

To see how these rules combine, take, for example, the situation in which an individual makes a payment of personal interest, and there is no evidence that the payment is qualified residence interest.

W = {Personal $\rightarrow$ Interest, QRI $\rightarrow$ Personal, Personal}

At first, we believe only what we can derive from our world: the payment is personal, and the payment is interest. Then we consider our first, most dominant rule that has not yet been applied: If a payment is qualified residence interest, then it is deductible (δ_1: *QRI $\rightarrow$ Deductible*). This rule is consistent with what we know, so we add it to what we believe. Now we believe everything that we can prove from W together with δ_1.

Next, consider the second most dominant rule: if an interest payment is personal, then it isn't deductible δ_2: *Personal $\rightarrow$ ¬Deductible*. That is also consistent with everything we know, so add that as well.

Finally, consider the third, weakest rule: if a payment is interest, then it's deductible δ_3: *Interest → Deductible*. This rule is not consistent with what we've already accepted. We've accepted that if interest is personal, it isn't deductible (δ_2: *Personal → ¬Deductible*). And we also know that the interest in question is personal (that was one of our initial facts). We don't know that the interest is qualified residence interest—that fact isn't in *W*, and we can't derive it from anything else we know. So from everything we have already accepted, we can derive that the interest isn't deductible. Thus, we can't add a rule that would have us conclude that the interest is deductible. So don't add δ_3 to the set of things we believe.

In the end, we should believe everything we can derive from *W* together with δ_1 and δ_2, among which is that the payment in question isn't deductible.

IV. WHY DEFAULT LOGIC?

This Part explains, first, why default logic more accurately represents rule-based legal reasoning than does standard logic, and, second, concrete advantages that result from using default logic over standard logic. I use section 163 as the example throughout this Part, but again, section 163 is in no way unique.

A. The Accuracy of Default Logic

First, strictly speaking, some metarule is required to know how to apply apparently conflicting statutory rules. Section 163(a), for example, states simply, "There shall be allowed as a deduction all interest paid or accrued within the taxable year on indebtedness." It does not say, for example, "*except as otherwise stated in this Section*, there shall be allowed as a deduction all interest paid. . . ." (There are sections of the Code that contain explicit carveouts; for example, section 61 states, "Except as otherwise provided in this subtitle, gross income means. . . ." But section 163(a) does not contain such language.) Section 163(h) seems, again, strictly speaking, inconsistent with the rule in section 163(a): "In the case of a taxpayer other than a corporation, no deduction shall be allowed . . . for personal interest paid or accrued during the taxable year."

How is one to reconcile "there shall be allowed as a deduction all interest" with "no deduction shall be allowed . . . for personal interest"? The statute itself does not tell us. Of course, this is not difficult to resolve; indeed, in this example, the task is so easy as to nearly disappear.

As the canons of statutory interpretation state, both the specific and general rule are to be given meaning, and the more specific rule (section 163(h)) dominates the more general rule (section 163(a)).[26] But simply on the statute's face, deductive logic is not sufficient to represent the rules.[27]

But in other situations the answer is less obvious. What advice should a lawyer give a taxpayer when, for example, the Internal Revenue Service (Service) declines to acquiesce in the decision of the Tax Court? Should the lawyer recommend that the client follow the court's ruling on the one hand, or the (opposite) revenue ruling on the other? To resolve the dilemma, the lawyer will take into account the extra-statutory rule that the revenue ruling means that the Service, which is charged with enforcing the tax law and would be the agency to pursue the taxpayer were he to file incorrectly, is committing not to pursue the taxpayer if he takes the approach described in the revenue ruling. In other words, the taxpayer-favorable revenue ruling controls. There are many sources of authority for interpreting statutes—different levels of government (federal, state, local); within each level, there may be different branches of government (legislative, judicial, administrative); and within each branch, different strengths of authority (for example, district court, appeals court, and so forth). One must know how to resolve conflicts among these various authorities to apply statutes correctly, and for the most part, the relative strength of these authorities is not contained in the statute one attempts to interpret.

This is consistent with Dworkin's approach to rules:

> [W]e cannot say that one rule is more important than
> another within the system of rules, so that when two
> rules conflict one supercedes the other by virtue of its

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26. *E.g.*, Townsend v. Little, 109 U.S. 504, 512 (1883) (referring to "the well-settled rule, that general and specific provisions, in apparent contradiction, whether in the same or different statutes, and without regard to priority of enactment, may subsist together, the specific qualifying and supplying exceptions to the general").

27. As Karl N. Llewellyn, *Remarks on the Theory of Appellate Decision and the Rules or Canons About How Statutes Are to Be Construed*, 3 Vand. L. Rev. 395, 401–06 (1949), notes, the canons, especially the substantive canons, can have a "thrust and parry" nature, with many canons having an equal and opposite canon—but in the core cases canons can resolve conflicts.

greater weight. If two rules conflict, one of them cannot be a valid rule. The decision as to which is valid, and which must be abandoned or recast, must be made by appealing to considerations beyond the rules themselves. A legal system might regulate such conflicts by other rules, which prefer the rule enacted by the higher authority, or the rule enacted later, or the more specific rule, or something of that sort. A legal system may also prefer the rule supported by the more important principles. (Our own legal system uses both of these techniques.)[28]

This description of appealing to other rules outside the system to decide which rule is to be discarded (overridden) is exactly the approach of defeasible reasoning and default logic. Dworkin characterizes the abandoned rule as "not valid," but it is perhaps more accurate to say that in a given situation, a particular rule might not apply because it is dominated by another rule.

Default logic also reflects more accurately the statutory structure. Even if the Code did say "*except as otherwise stated in this Section*, there shall be allowed as a deduction all interest paid," and even if no authorities conflicted, to take the deductive approach would miss the structure of the Code. The Code is not flat. Section 163 itself is not flat: Section 163(a) is the "general rule" (that is its title), with various subrules and exceptions that follow. And it is itself embedded in a title (Title 26, which includes all tax law), a subtitle (Subtitle A, income taxes), chapter (Chapter 1—normal taxes and surtaxes), subchapter (Subchapter B—computation of taxable income), and part (Part VI—itemized deductions for individuals and corporations).

These divisions are far from incidental. The law itself is defined by these groupings, as some sections include definitions "for purposes of this Part," or "for purposes of this Subchapter," and so forth. Financial consequences of these groupings can be significant: when the net investment income tax (NIIT) was created in 2013, it was placed in Chapter 2A of the Code, thus making NIIT payments ineligible for the foreign tax credit. By its terms, the foreign tax credit is available only for taxes imposed by "this chapter" (section 901). Because of the location of

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28.   Ronald M. Dworkin, *The Model of Rules*, 35 U. Chi. L. Rev. 14, 27 (1967).

section 901, the credit is available only for those taxes imposed by Chapter 1 of the Code. And neither are the NIIT payments covered by social security totalization treaties, which apply only to those taxes imposed by Chapter 2 of the Code. These limitations, and the resulting double tax, are apparent nowhere on the face of the statute, but are entirely due to the location of the NIIT in the Code. The Code's structure matters.

It's not surprising that default logic accurately reflects the statutory structure, as the general-to-specific approach (general rules followed by exceptions) is the approach recommended by legislative drafters. For example, a manual created by the office in the House of Representatives that drafts legislation and intended as a "guidebook for individuals who are undergoing . . . on-the-job drafting training," urges drafters to follow, as much as possible, a general-to-specific organization:

> Before choosing an organization for a draft, determine to what extent it could appropriately fit into the following arrangement:
>
> (1) GENERAL RULE.—State the main message.
>
> (2) EXCEPTIONS.—Describe the persons or things to which the main message does not apply.
>
> (3) SPECIAL RULES.—Describe the person or things—
>
> > (A) to which the main message applies in a different way; or
> >
> > (B) for which there is a different message.[29]

The Senate legislative drafting manual contains a similar exhortation:

> IN GENERAL—A section contains some or all of the following provisions and is organized as follows:
>
> > SEC. 101. SECTION HEADING.
> >
> > > (a) DEFINITIONS.—
> > >
> > > (b) GENERAL RULE.—

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29. OFFICE OF THE LEGISLATIVE COUNSEL, U.S. HOUSE OF REPRESENTATIVES, HOUSE LEGISLATIVE COUNSEL'S MANUAL ON DRAFTING STYLE 23 (1995).

(c) EXCEPTIONS.—

(d) SPECIAL RULES.—[30]

This organization is also how people describe the law: in Revenue Ruling 2010–25, for example, the Service begins by stating the general rule (a deduction is allowed for interest payments), then introduces the first exception (there is no deduction for personal interest) and then the last exception, the least general rule (there is a deduction for qualified residence interest). The same approach appears in any textbook,[31] treatise,[32] or case.[33]

That said, a nonmonotonic logic such as default logic isn't *necessary* for representing defeasible reasoning. Take section 163, for example. One arrives at the correct answer (deductible or not deductible) with just one rule, in standard monotonic logic: If a payment is interest, then it is deductible if and only if either it is not personal, or it is qualified residence interest. That is,

$$\text{Interest} \rightarrow (\text{Deductible} \leftrightarrow (\neg\text{Deductible} \lor \text{QRI})).[34]$$

Thus Dworkin proposes that rules are "all-or-nothing": an "accurate" statement of a rule takes all exceptions into account and "legal consequences that follow automatically."[35]

Or perhaps the choice between representing rule-based legal reasoning using, on the one hand, a nonmonotonic logic, or, on the other, a monotonic logic is a false choice: other nonstandard logics may actually be better suited to represent rule-based legal reasoning.[36]

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30.   Office of the Legislative Counsel, U.S. Senate, Legislative Drafting Manual 9 (1997).

31.   *E.g.*, Richard Schmalbeck et al., Federal Income Taxation 383–386 (4th ed. 2015).

32.   *E.g.*, Bittker & Lokken, *supra* note 24, at ¶ 31.1.

33.   Pau v. Comm'r, T.C. Memo 1997–43, 1997 WL 28678.

34.   This isn't an exhaustively accurate statement of the law but rather a summary of the few exemplary rules described in this Essay.

35.   Dworkin, *supra* note 28, at 25.

36.   *See, e.g.*, John Nolt et al., *A Logic for Statutory Law*, 35 Juri-metrics 121 (1995) (proposing a logic for statutory reasoning that is closely

But my claim isn't that default logic is *required* to represent rule-based legal reasoning, but rather that default logic is *preferable* for formalizing such reasoning, as compared both to standard nonmonotonic logic and to other nonstandard logics. Whether to use default logic in a particular situation is a question of pragmatics.[37] What logic is best depends on one's purpose. Nolt, for example, aims to find a logic that permits artificial intelligence to reach accurate legal conclusions.[38] For that purpose, whether the logic accurately reflects, for example, the statutory structure is of little interest. But in the case of rule-based legal reasoning, the pragmatics is on the side of default logic, as the next Subpart describes.

B. The Benefits of Default Logic

Because default logic more accurately reflects the structure of statutes and the practice of rule-based legal reasoning than does standard logic, using default logic to represent rule-based legal reasoning in general, and statutory reasoning in particular, has both theoretical and practical benefits.

First, using default logic to represent rule-based legal reasoning highlights the conceptual category *rule priority*, a category that crosscuts legal reasoning and is implicit to what much of lawyers do, but remains undertheorized. As an initial matter, certain types of rule priority seem obvious. A statute (for example) obviously dominates, say, a notice from the Service. In some sense this is accurate; a statute is enacted by Congress and signed by the President, whereas an administrative agency notice is simply a statement of how an administrative agency will administer the law. On the other hand, if the enforcer tells you that it will not enforce the law, then it seems safe to violate the law, and the enforcer's notice dominates the statute. This is precisely what happened when, for example, in Notice 2008–76, the Service announced that it would not enforce a provision of section 382 against banks, effectively transferring over $100 billion to certain private parties in violation of explicit, clear statutory law. No lawyer would advise his client to follow the statute and not the Notice.

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related to relevance logic, which adds constraints to the conditional in order to require a relation between the premise and the conclusion).

  37. Hage, *supra* note 4.
  38. Nolt, *supra* note 36, at 122.

More generally, in many situations there may be a variety of different "right" answers to a question of law, depending on the precise question one is asking. The right answer might be, for example, "the answer that is most compliant with the law," or the right answer might be "the advice that a tax lawyer should give a risk-averse client," or the right answer might be "the conclusion a judge would reach." Default logic's formalization will in fact be able to provide any of those three answers (and others!), even though the answers might be different than one another, depending on the priority the formalizer gives to the various rules. In this Essay, "right answer" means "the advice that a tax lawyer should give a risk-averse client," and the rules are ordered accordingly. A tax lawyer giving advice to a client would, for example, give a recent Service ruling higher priority than a Supreme Court opinion that held to the contrary, notwithstanding that a Supreme Court opinion has, in some very important sense, more authority. Conceiving of rule-based legal reasoning as defeasible reasoning, reasoning that is best formalized by a nonmonotonic logic such as default logic, thus suggests another area, rule priority, to which more attention should be paid.

Second, because default logic tracks the structure of statutes and statutory drafting, it is easier to convert statutes into default logic than into standard logic. Consider again section 163. Extracting the three default rules[39] from the statute is straightforward; indeed, each rule can be cited to a particular subsection. In contrast, creating the single rule that captures section 163 in standard logic requires applying metarules and deviating from the statutory structure. Artificial intelligence based on default logic can more easily encode statutes and extract information from statutes than artificial intelligence based on standard logic.[40] For example, just as e-discovery extracts factual information from large amounts of text, computer programs looking for default logic-type arguments could check to see what kind of arguments have been successful before courts or administrative agencies. And it would be easier and less

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39.   I.e., the rules in Δ.

40.   For an initial attempt to use natural language processing to extract default-logic rules from the tax law, see Marcos Pertierra, Sarah Lawsky, Erik Hemberg, & Una-May O'Reilly, Towards Formalizing Statute Law as Default Logic Through Automatic Semantic Parsing (July 2017), http://groups .csail.mit.edu/EVO-DesignOpt/groupWebSite/uploads/Site/ASAIL_2017_ Pertierra.pdf (proceedings of Second Workshop on Automated Detection, Extraction and Analysis of Semantic Information in Legal Texts (ASAIL)).

expensive to create programs meant to apply the law if the programs are written in languages that more closely track the actual structure of the Code. For example, one could tag certain rules with priorities instead of having to manually combine the rules to get the right answer.

Third, and relatedly, if formalizing statutes is relatively easy, drafters may be more likely to use formalization to check the structure of the statute, which might help avoid errors and unintentional ambiguities. Consider, for example, the definition of acquisition indebtedness. Is acquisition indebtedness the amount incurred in acquiring, etc., the qualified residence and secured by that residence? Or is it the amount *up to $1 million* that is incurred, etc.? Put another way, is the $1 million limitation part of the definition of "acquisition indebtedness"? Or is it a limit on how much acquisition indebtedness there may be?

Why does this matter? Because definitions are extensional: if $X = Y$, then anywhere in the Code that X appears, one can substitute Y *salva veritate*. So what should substitute for acquisition indebtedness in the portion of the definition of home equity indebtedness that limits home equity indebtedness to the excess of the fair market value over the acquisition indebtedness? "Amount incurred in acquiring, etc." or "amount incurred in acquiring, etc. up to $1 million"? If the latter, then if a taxpayer borrows $1.1 million to acquire his home, he may deduct the interest with respect to the first $1 million as interest with respect to acquisition indebtedness, and the interest with respect to the last $100,000 as interest with respect to home equity indebtedness. If the former, then the last $100,000 cannot be home acquisition indebtedness.

The issue has been extensively litigated. The government argued first that the definition did not include the $1 million limitation, and thus that the last $100,000 did not constitute home equity indebtedness. Although the government won in court in *Pau v. Commissioner*, the Service later backed off their (winning) position and permitted the second $100,000 to count as home equity indebtedness. Had the drafters formalized their statute to check its structure, they would have had to decide what was included in the definition of acquisition indebtedness and would have resolved what seems to be an unintentional ambiguity.[41]

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41.   For further discussion, see Sarah B. Lawsky, *Formalizing the Code*, 70 Tax L. Rev. 377 (2017).

V. CONCLUSION

This Essay argues that formal logic is a useful way to model rule-based legal reasoning if one uses a nonstandard logic. In particular, using the example of section 163 of the Internal Revenue Code, the Essay argues that certain types of rule-based legal reasoning are defeasible reasoning and best modeled by default logic. Finally, the Essay suggests both theoretical and practical advantages of using default logic to model rule-based legal reasoning.