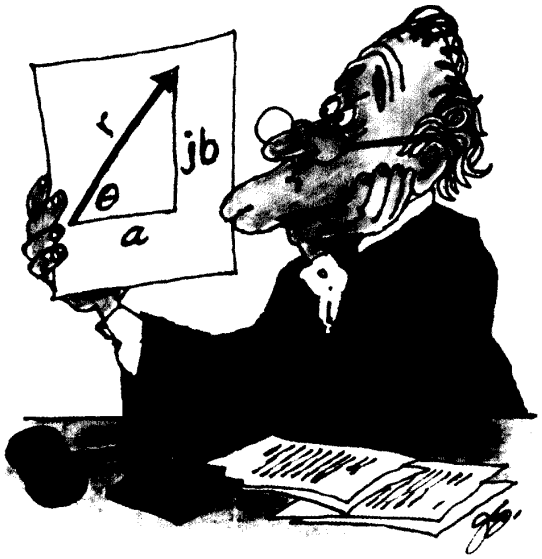
Micro Law



Fuzziness versus all or nothing

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A cornerstone of Aristotelian logic is the rule that a given thing either does or else does not do something, or that a given thing either has or else does not have a given property. That is, *P(x) OR not-P(x).* Restated, the function P(x), where x is a thing and P( ) refers to a given property P of such things, means that things are engaging in some action P and has the truth value of either 0 or 1.

Together with the rule that a double negation is an affirmation, the rule *P(x) OR not-P(x)* implies that a given thing cannot both have and not have a given property, and cannot be both doing and not doing a given thing, at the same time. Hence the truth value of the logical product *P(x) AND not-P(x)* is 0.

Of course, at least as early as the 19th century people knew that even if Aristotelian logic applied to how or what things are, it did not apply in the same way to what we know about what things are. Thus, even assuming that p is true or false, and that if p is not true, it is false, and that it cannot be both true and false at once, the same principles do not apply to a proposition such as "It is known that p is true."

That proposition can be false, and instead the following proposition may be true: "It is known that p is false." However, the first quoted proposition can be false, also, when it is unknown whether p is true or p is false. In other words, *It is not known that p is true, AND it is not known that p is false.* Hence the truth value of the logical product *not-**K**[P(x)] AND not-**K**[not-P(x)]* can be 1. To replace the previous statement, it need not be true that ***K**[P(x)] OR**K**[not-P(x)].*

That led to the development of three-valued, non-Aristotelian logic, in which all or nothing was no longer the case. A proposition could have truth value 0, 1, or X. That fit in nicely in the 1950s with magnetic core memory, which could have +, −, or 0 polarization, and suggested use of trinary rather than binary notation. It also fit in with circuits (such as latches) that might have signal values 1, 0, or X, where X meant "don't care" or "value depends on initial state."

It was only a matter of time before Lotfi Zadeh, the promoter of fuzzy logic, decided that if having three values was good, why not have 4, 8, 16, or as many as you want running from 0.0 to 1.0. Some concepts, such as damp/dry in a clothes dryer or bright/dim for a light bulb, can be better described that way. That has led, as articles in this issue will tell you, to miraculously improved control systems. (See the next issue for comments from one of fuzzy logic's detractors, professional debunker Bob Pease of National Semiconductor. So, claims for the superiority of fuzzy logic will not have to go unchallenged.) That suggests the question whether law, particularly intellectual property law as applied to electronic systems, might benefit from a stiff dose of fuzzy logic.

Intellectual property law has enjoyed a kind of fuzzy logic in the past. An example is the piece of copyright law proceeding from the premise that a computer program is a literary work like poems or a novel, whose plot and other nonliteral aspects are legally protected, and *therefore* a computer program should enjoy legal protection of its nonliteral aspects, such as the patterns of commands and key strokes that actuate the Lotus 1-2-3 spreadsheet program. That is *not* the kind of fuzzy logic I mean. I mean Zadehian fuzzy logic, as contrasted with Aristotelian or Boolean logic.

The law in general, and intellectual property law is no exception, tends to take an all or nothing (binary) attitude about everything. Winner

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takes all, loser is pulverized. Thus, consider again Lotus and its lawsuits to protect its alleged legal rights to slash-F-R and so on in spreadsheet programs. Readers will recall that several years ago, Judge Keeton ruled in favor of Lotus on this issue and against Paperback Software. Paperback then went belly up, and Adam Osborne moved on toward other horizons. Lotus then followed up its victory over Paperback by suing Borland over Quattro Pro's emulation of 1-2-3, and Jim Manzi vowed to "perform a cashectomy on Philippe Kahn." Again, Judge Keeton ruled in favor of Lotus, confirming its entitlement to copyright protection for such nonliteral aspects of the program as the command structure of 1-2-3.

Part of the court's legal theory was that if users do not like to learn new interfaces, that's their problem. It then looked as if Borland owed Lotus more money than Borland had. With both Lotus and Microsoft having been enthusiastically "sticking it to Philippe" (see Micro Law, April 1995) and company profits plummeting, Kahn stepped down as Borland's CEO, and Manzi's promised cashectomy appeared both imminent and an understatement. Copyright law's all-or-nothing approach appeared then to be dictating total victory for Lotus over Borland, with the crushed loser stumbling into bankruptcy.

In a recent about-face ruling, however, the US court of appeals in Boston reversed Judge Keeton's ruling on appeal, and totally exonerated Borland. The court held that Borland had taken merely an unprotected "method" from Lotus when it used the 1-2-3 commands and keystrokes. Since copyright law does not protect so-called methods, because they are akin to the idea of a computer program rather than its protected expression, Lotus can recover nothing. No Manzi cashectomy on Philippe!

How would Zadeh address this controversy, using a notional fuzzy copyright law system? Presumably, instead of Lotus having a legally protected interest in the 1-2-3 keystrokes and commands of value either 1.0 (per Judge Keeton) or 0.0 (per the court of appeals), Lotus would have something in between, possibly 0.34. Moreover, instead of Borland being 1.0 naughty (per Judge Keeton) in emulating as much of the command structure as it did and in the manner that it did so, Borland would have some intermediate degree of culpability, perhaps 0.54. It is left as an exercise for the reader to determine how much of a cashectomy on Borland the fuzzy copyright system would inflict on behalf of Lotus.

In principle, this would seem a better approach. Ordinarily, a function assumes during ordinary operation some value intermediate of its extremes. Often, a function more or less monotonically ascends from a value near zero at the left extreme to a higher value (which we may normalize as 1.0) at the right extreme. Or it does the opposite, more or less monotonically descending toward a value near zero at the right extreme from a higher value (which we may normalize as 1.0) at the left extreme.

Let us now postulate a social value function $y = F(u,v,w, ..., z)$ that represents the benefit to society from some system, such as copyright law, where u,v,w, ..., z represent parameters determined by other functions. These functions are of the type described in the preceding sentences, where the left and right extremes represent a range of behavior from "on the one hand" to "on the other hand." When products occur in social-value function F, a 0 value results whenever any relevant behavior is characterized and given a parameter value of 0, even if the other parameters receive a value of 1. This tends to make left ("on the one hand") and right ("on the other hand") values of F be 0. Thus, assume $y = F(x) = F[G(x),H(x)]$, where $G(x) = x$, $H(x) = e^{-x}$, and $y = F = GH$. Then, $F(x) = xe^{-x}$, and F is a maximum for intermediate x, but is or approaches 0 at left and right.

How much of a cashectomy on Borland would the fuzzy copyright system inflict on behalf of Lotus?

That suggests that you have a see-saw too often: Winner takes all, when the rights and wrongs are not all that clear, but the system grinds everything down into either 1s or 0s. One might think it preferable, therefore, to develop a Zadehian logic for intellectual property rights in software or other legal rights. That might lead to a more stable system.

On the other hand, compromise solutions are not always so good. Sometimes, they combine the worst aspects of what is available—a pork barrel for everyone who agrees to help roll someone else's log. But nonparticipants in the process pay the bill for the pork. Perhaps sometimes the social value function $F(x) = xe^{-x}$, in which case it is a maximum in the middle, and other times perhaps $F(x) = 1 - xe^{-x}$, in which case it is a minimum in the middle and a maximum at both of the extremes.

How does one decide which of the following two processes is better?

1. (This time) Judge Keeton authorizes Manzi's cashectomy on Philippe, but (this time) the court of appeals countermands that

prescription.

2. Manzi just performs on Philippe a fraction of a cashectomy, 1/x, where $0 < x < \infty$.

The problem is that one simply cannot determine by a priori abstract analysis whether the social utility function for a given legal regime is more like xe^{-x} or is more like $1 - xe^{-x}$. For all you know, the function is like $y = ax$ or like $y = 1 - ax$, or even like $y = c$.

Instead, one must take a number of actual, decided cases (or, if worse comes to worst, a number of hypothetical cases) and determine how they would have come out under the proposed alternative system (here, Zadehian legal logic). Then, one decides whether the old regime's result or the new regime's result (if different) is intuitively better. Only after extensive "field testing" of this kind can you determine, if ever, whether a proposed legal change will be for the better or worse.

I suspect that doing this with Zadehian logic will lead to inconclusive results, and I therefore invite someone else to do all of the work. My suspicion, confided here, is that a fundamentally new version of Zadehian logic is needed to address the problems of making legal logic something other than an oxymoron. The leap forward that Zadeh's system needs is to stop being hidebound—confined by the chauvinism of the real number system. What of j?—i to any of you non-EEs out there. Legal truths should be represented in value as r,θ, where $0 < r < 1$ and $0 < \theta < 2\pi$, or by the $a + jb$ equivalent. Then, and only then, we will have a system that maps legal truth to its real-world perceived value.