Tackling fuzziness and uncertainty

F.H. George

Logic Machines and Diagrams.
By Martin Gardner.
Harvester/University of Chicago Press: 1982. Pp.176. Hbk £15.95, $15; pbk £4.95, $5.95.

MARTIN Gardner has written a very exciting book, one which anyone interested in what might broadly be called Information Technology should read. The emphasis is, as one might expect, primarily mathematical, taking us from the thirteenth-century world of Ramon Lull up to the present-day concepts of machine intelligence.

Mathematical logic plays a leading role in the book. Several chapters are devoted to methods of representing logic and logical arguments that are traditionally associated with the Euler–Venn diagrams (although Venn was associated primarily with a form of elliptical representation of class relationships more complicated than those circular representations associated primarily with Euler).

The part of the book of greatest current interest is to be found in a final chaper devoted to machine intelligence. Here such important matters as Robinson's Resolution method of theorem proving, and binary semantic trees are discussed, with probabilistic logic (now long established) and fuzzy logic (a much more recent development) also coming in for consideration. It is clear that the fuzziness in logic represents some of the fuzziness inherent in ordinary language; it serves as a reminder that this aspect of logic does not lie in the direction of the great traditional developments of mathematical logic, which were concerned primarily with the foundations of mathematics. It should be said that uncertainty in logical inference making can involve uncertainty over the class definition (e.g. the class of neurotic people) or over whether a particular member (person) belongs to that class (e.g. Is Charles neurotic?). The uncertainty over the latter point may merely occur because we do not know enough about Charles. Such uncertainty is represented in fuzzy logic.

Two especially thought-provoking questions are proposed by the author: "[is it] possible to formalize a computer language that will model fuzzy reasoning in useful ways"; and "is there a useful way . . . to diagram fuzzy logics with fuzzy diagrams?". The word "useful" stalks us in both these quotations, but certainly, as is acknowledged in the book, Zadeh himself (who first coined the expression "fuzzy system" in 1965) is working towards an answer to the first point. One can also think of a number of ways, using dotted lines and the like, that the second may be tackled, although the usefulness of the results is uncertain. In both cases the key point seems to be, as with probabilities, that the language which describes uncertainty, which may or may not be measureable, is itself certain.

One assertion — perhaps the only one in the whole book — gave me pause, and cause for disagreement with Gardner: "How the human mind works remains, of course a profound mystery". Not really! We do not know with certainty, of course, but most people would say that we know a great deal about the mind, even if we are unsure of the exact workings of the mechanism.

This is a field where much remains to be done, though "profound mystery" is surely an exaggeration. But here, perhaps, Gardner has taken poetic licence. The question of Gödel's theorem and its relation to machine thinking has been disposed of and it is recognized that machines that hope to achieve human flexibility of thought must operate heuristically. Granted they can do so, there is no reason to argue that machines could not think and behave as intelligently as human beings can. All this is recognized by Martin Gardner, as is the close relationship between machine intelligence and philosophy, in this truly excellent book. □

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Counting the cost

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The Medical Effects of Nuclear War.
The Report of the British Medical Association's Board of Science and Education.
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THE EFFECTS of nuclear war have been studied extensively for nearly four decades, and the argument has been advanced that we already know everything about the topic that there is to be known, at least in its scientific aspects. Indeed, at a recent debate in a prestigious scientific society in the UK this argument was successfully used to quash a project for further study.

It seems odd that such a view should be adopted by scientists in relation to a subject about which there is no experience, but which produces new phenomena at a rate of one per decade. Thus, it was not realized until the early 1960s that the malfunction of electronic equipment during nuclear tests was due to the electromagnetic pulse emitted at explosions. The depletion of the ozone layer in the stratosphere began to be discussed in the 1970s. And it was only a year ago that a new effect was predicted: the dramatic reduction of sunlight resulting from the injection into the troposphere of huge quantities of soot from the