AI Magazine Volume 13 Number 1 (1992) (© AAAI)

Letters

■ **Editor:**

The recent article by Roger C. Schank ("Where's the AI", *AI Magazine*, Winter, 1991) brought a broad nostalgic smile to my face. I believe that I am the unnamed Yale junior faculty member to whose work Prof. Schank alluded. Perhaps the intervening years have eradicated his memory of my name or, more likely, he wished to spare me the ignominy of serving as one of his principal strawmen. I, however, fully mindful of Oscar Wilde's observation that the only thing worse than being talked about is not being talked about, would not have been insulted by being identified. But, my purpose in writing is neither to defend my scientific integrity nor to dispel my anonymity. Rather, I wish to comment on Prof. Schank's analysis.

Let me say at the outset, that I subscribe wholeheartedly to the scaleup criterion of validity that Prof. Schank applies to research in AI. I do prefer to think of it as Dreyfus' First Step Fallacy encapsulated in the metaphor of not being able to reach the moon by climbing a tree. Regardless of its expression, however, the utmost care is required in applying a scalability measure to an experimental implementation of an idea, because there exists no universal measure of scalability but, instead, a large family of them, each appropriate to the specific method employed.

Thus, although Prof. Schank's recollection of my work is essentially correct, his conclusion that my method cannot scale up is utterly specious. It is quite true that in 1974 I was working on recognition of isolated spoken words. The vocabulary was not, as he relates, the ten digits but a set of 43 words appropriate for programming a computer by voice. For this application it was natural to include in the recognition process both the syntax and semantics inherent in the programming language itself. This clarification is not crucial to my main point, though. What is important is that the assertion that isolated word recognition is of no general value, while seeming plausible, is actually wrong.

The principles of statistical pattern recognition I had employed then are very general indeed. In fact, those very principles form the basis of all contemporary speech recognition systems which, in their best incarnations here at Bell Laboratories and elsewhere, are capable of accurately transcribing fluent speech of virtually any speaker talking about a specific topic and using a vocabulary of thousands of words!

Of course, these modern systems model several levels of linguistic structure the existence of which most engineers have long been aware. Prof. Schank seems to be unaware that the methods of statistical pattern recognition extend naturally to many forms of linguistic regularity. It is simply the case that, for a variety of purely practical reasons, it was, in 1974, merely convenient to conduct experiments at the lexical level to demonstrate a proof in principle. It was, of course, well understood that, because the underlying mathematics captured something fundamental about classifying sound patterns, it could be applied equally well to any hierarchy of such patterns. Modern speech recognition systems have vindicated that early understanding. Incidentally, the phenomenon of broad mathematical applicability is not restricted to speech recognition. A quite general account of it is given in a delightful paper by the renowned physicist Eugene Wigner entitled The Unreasonable Effectiveness of Mathematics in the Natural Sciences (*Comm. Pure Appl. Math.*, 13(1), 1960).

Although it is important to note that Prof. Schank's use of my early research as a prototype of non-generalizable technique is completely unjustified, there is a more significant point to be made. I ask researchers in our field to consider what caused Prof. Schank to choose such an obviously flawed example. I submit that it is because of a tendency we all display at one time or another to become fixated on a single aspect of a very complex question. In some mature and highly technical disciplines, this mode of thought can be effective. Unfortunately, this is not the case in our chosen pursuit of the essence of mind which should be seen as a young and interdisciplinary enterprise.

When nature produced intelligent organisms, she was not constrained by the academic boundaries that have since evolved. If we are to understand her handiwork, we must transcend these arbitrary divisions and the parochial viewpoints they foster. Intelligence comprises many kinds of processes which admit of different kinds of analytical treatment each having its peculiar origin, development and formalism. Near the sensory-motor periphery, the physics of the sensors and actuators is essential. In cognition, the computational aspects assume importance. In between lies a complex array of diverse components. Moreover, the entire system is embedded in a marvelous feedback control system thereby allowing learning to take place. Intelligence is the collective result of all of these parts operating in symphony. The construction of an artificial intelligence will surely require more than encoding crude metaphors for these parts in software. Rather, faithful quantitative models hard wired to reality will be necessary. Therefore, summary dismissal of approaches to AI that originate outside one's area of expertise and are thus unfamiliar, is counterproductive.

In our department, we study language in general and as it applies to important practical problems in telecommunications. Among us are mathematicians, physicists, psychologists, linguists, electrical engineers and computer scientists. It requires special effort and discipline, but we try to keep each other informed of our different conceptualizations of our common problems. We believe that this mixture of specialities practiced in a cooperative environment, will lead to deep understanding in the long term.

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■ **Editor:**

In Eugene Charniak's recent article in *AI Magazine* (Charniak 1991), his insight into the interplay of Bayesian networks with numerous domains is welcome to those who have worked in relative obscurity. Specifically in application to computer vision, I want to expand upon and correct a reference, for the benefit of those readers who would like to look into this further. Charniak's citation of Levitt, Agosta, and Binford (1990) has an author stated incorrectly, perhaps by confusion with an earlier, seminal paper (Binford, Levitt, and Mann 1989) Since then there have been some advances in the stucture of a network necessary to carry out vision (Agosta 1991; Agosta 1991a; Agosta 1990).. Other work may be found in a working paper from an ESPRIT project (Jensen, Nielsen, and Christensen 1990) and in the annual DARPA Image Understanding workshop proceedings.

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