Classic Papers: Review/Analysis

Title and Author:

Title: The Appeal of Parallel Distributed Processing

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Knowledge Relating to the Cognitive Science Program Learning Outcomes

1. Neural Networking

   a. But what is the internal structure of each of the states in the sequence, and how do they come about? Serious attempts to model even the simplest macrosteps of cognition-say, recognition of single words-require vast numbers of microsteps if they are implemented sequentially. As Feldman and Ballard (1982) have pointed out , the biological hardware is just too sluggish for sequential models of the microstructure to provide a plausible account , at least of the microstructure' of human thought. And the time limitation only gets worse, not better, when sequential mechanisms try to take large numbers of constraints into account. Each additional constraint requires more time in a sequential machine, and, if the constraints are imprecise, the constraints can lead to a computational explosion. Yet people get faster, not slower, when they are able to exploit additional constraints.

2. Symbol Systems

   a. Representations like scripts, frames, and schemata are useful structures for encoding knowledge, although we believe they only approximate the

underlying structure of knowledge representation that emerges from the class of models we consider in this book, as explained in Chapter 14. Our main point here is that any theory that tries to account for human knowledge using script-like knowledge structures will have to allow them to interact with each other to capture the generative capacity of human understanding in novel situations. Achieving such interactions has been one of the greatest difficulties associated with implementing models that really think generatively using script- or frame-like representations.

3. Language

   a. On the other hand, if the information specifying whether the function word preceding the final word is to or the is ambiguous, then the typical reading of the word that follows it will determine which way the function word is heard. This was shown in an experiment by Isenberg, Walker, Ryder, and Schweikert (1980). They presented sounds halfway between to (actually /t/) and the (actually /d/) and found that words like joke which we tend to think of first as nouns, made subjects hear the marginal stimuli as the while words like drive which we tend to think of first as verbs, made subjects hear the marginal stimuli as to. Generally, then, it would appear that each word can help constrain the syntactic role, and even the identity, of every other word.

4. Psychological Investigations

   a. One very prominent feature of human memory is that it is content addressable. It seems fairly clear that we can access information in memory based on nearly any attribute of the representation we are trying

to retrieve. Of course, some cues are much better than others. An attribute which is shared by a very large number of things we know about is not a very effective retrieval cue, since it does not accurately pick out a particular memory representation. But, several such cues, in conjunction can do the job. Thus, if we ask ' a friend who goes out with several women , Who was that woman I saw you with?" , he may not know which one we mean-but if we specify something else about her-say the color of her hair, what she was wearing (in so far as he remembers this at all), where we saw him with her-he will likely be able to hit upon the right one.

5. Neural Networking

   a. We already have noted Hebb' s contribution of the Hebb rule of synaptic modification; he also introduced the concept of cell assemblies-a concrete example of a limited form of distributed processing-and discussed the idea of reverberation of activation within neural networks... Lashley s contribution was to insist upon the idea of distributed representation... Yet many of his insights into the difficulties of storing the " engram" locally in the brain are telling, and he seemed to capture quite precisely the essence of distributed representation in insisting that" there are no special cells reserved for special memories " (Lashley, 1950, p. 500).