CSC: Classic Paper Review/Analysis #3

Title and Author

Title: The Appeal of Parallel Distributed Processing

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Summary/Hook

This articles explores the phenomena of human cognition which is a widely examined topic in many different fields of study, including artificial intelligence and cognitive science. The authors proposes a new approach to studying cognition, by developing a processing system that models the internal structure of human cognition, through the use of neural networks. This new approach was called parallel distrusted processing and the model is disused in depth using many supporting examples. After the authors break down the ins and outs of how the processing model would even begin to resemble cognition as we know it. The article concludes with the authors combating the common argument and critics that are associated with their theory.

Knowledge Relating to the Cognitive Science Program Learning Outcomes

1. Formal Systems and Theories of Computation

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.

2. Neural Networks

To articulate these intuitions, we and others have turned to a class of models we call Parallel Distributed Processing (PDP) models. These models assume that information processing takes place through the interactions of a large number of simple processing elements called units , each sending excitatory and inhibitory signals to other units. In some cases , the units stand for possible hypotheses about such things as the letters in a particular display or the syntactic roles of the words in a particular sentence. In these cases, the activations stand roughly for the strengths associated with the different possible hypotheses, and the interconnections among the units stand for the constraints the system knows to exist between the hypotheses. In other cases , the units stand for possible goals and actions, such as the goal of typing a particular letter, or the action of moving the left index finger, and the connections relate goals to subgoals, subgoals to actions , and actions to muscle movements. In still other cases, units stand not for particular hypotheses or goals , but for aspects of these things. Thus a hypothesis about the identity of a word, for example, is itself distributed in the activations of a large number of units.

3. Psychological Investigations

Perceptual completion of familiar patterns. Perception, of course , is influenced by familiarity. It is a well-known fact that we often misperceive unfamiliar objects as more familiar ones and that we can get by with less time or with lower-quality information in perceiving familiar items than we need for perceiving unfamiliar items. Not only does familiarity help us determine what the higher-level structures are when the lower-level information is ambiguous; it also allows us to fill in missing lower-level information within familiar higher-order patterns. The well- known phonemic restoration effect is a case in point. In this phenomenon, perceivers hear sounds that have been cut out of words as if they had actually been present. For example, Warren (1970) presented legi#lature to subjects, with a click in the location marked by the #. Not only did subjects correctly identify the word legislature; they also heard the missing /s/ just as though it had been presented. They had great difficulty , localizing the click, which they tended to hear as a disembodied sound. Similar phenomena have been observed in visual perception of words since the work of Pillsbury (1897).

4. Psychological Investigations

It is , of course, possible to implement some kind of content addressability of memory on a standard computer in a variety of different ways. One way is to search sequentially, examining each memory in the system to find the memory or the set of memories which has the particular content specified in the cue. An alternative somewhat more efficient, scheme involves some form of indexing keeping a list, for every content a memory might have, of which memories have that content. Such an indexing scheme can be made to work with error-free probes, but it will break down if there is an error in the specification of the retrieval cue. There are possible ways of recovering from such errors, but they lead to the kind of explosions which plague this kind of computer implementation

5. Language and Culture

Our knowledge of syntactic rules alone does not tell us what grammatical role is played by the prepositional phrases in these two cases. In the first , " flying to New York" is taken as describing the context in which the speaker saw the Grand Canyon-while he was flying to New York. In the second , " grazing in the field" could syntactically describe an analogous situation, in which the speaker is grazing in the field, but this possibility does not typically become available on first reading. Instead we assign grazing in the field n as a modifier of the sheep (roughly, who were grazing in the field"). The syntactic structure of each of these sentences , then , is determined in part by the semantic relations that the constituents of the sentence might plausibly bear to one another. Thus, the influences appear to run both ways , from the syntax to the semantics and from the semantics to the syntax