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Classic Paper 3: Review/Analysis

Title and Author

Title: *The Appeal of Parallel Distributed Processing*

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Summary/Hook

This paper famously introduces a computational framework for modeling cognitive processes called *parallel distributed processing*. Many examples of PDP models are given including for: *Motor Control, Perception, Information Retrieval From Memory,* and *Learning/Representation*. Lastly, credit is given to the work of the many psychologists and neurologists who's work contributed to the eventual creation of PDP models.

Knowledge Related to the Cognitive Science Program Learning Outcomes

1. **Language and Culture**

   It is clear, of course, that syntax constrains the assignment of meaning. Without the syntactic rules of English to guide us, we cannot correctly understand who has done what to whom in the following sentence: The boy the man chased kissed the girl. But consider these examples (Rumelhart, 1977; Schank, 1973*): I saw the grand canyon flying to New York. I saw the sheep grazing in the field.* 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.

2. **Symbol Systems**

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. **Embodiment, Emergence, and Distributed Cognition**

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.

4. **Foundational Assumptions**

Computational approaches to learning fall predominantly into what might be called the " explicit rule formulation " tradition, as represented by the work of Winston (1975), the suggestions of Chomsky, and the ACT'" model of 1. R. Anderson (1983). All of this work shares the assumption that the goal of learning is to formulate explicit rules (propositions , productions , etc.) which capture powerful generalizations in a succinct way. Fairly powerful mechanisms , usually with considerable innate knowledge about a domain, and/ or some starting set of primitive propositional representations , then formulate hypothetical general rules , e. , by comparing particular cases and formulating explicit generalizations.

5. **Neural Networking**

One was Rosenblatt (1959, 1962) and the other was Selfridge (1955). In his Principles of Neurodynamics (I 962), Rosenblatt articulated clearly the promise of a neurally inspired approach to computation, and he developed the perceptron convergence procedure an important advance over the Hebb rule for ..J THE POP PERSPECTIVE changing synaptic connections. Rosenblatt s work was very controversial at the time, and the specific models he proposed were not up to all the hopes he had for them. But his vision of the human information processing system as a dynamic, interactive , self-organizing system lies at the core of the PDP approach.