Computer Science as Empirical Inquiry: Symbols and Search

Summary

This 1975 paper by Simon and Newell discusses their formulated Physical Symbol System Hypothesis. A Physical Symbol System is a set of symbols which are combined into structures and then are used to make new expressions. Simon and Newell argue in their paper that physical symbol systems are means for general intelligent action.

Knowledge Relating to the Cognitive Science Program Learning Outcomes

1.) Symbol Systems

A physical symbol system consists of a set of entities, called symbols, which are physical patterns that can occur as components of another type of entity called an expression (or symbol structure). Thus, a symbol structure is composed of a number of instances (or tokens) of symbols related in some physical way (such as one token being next to another).

2.) Psychological Investigations

Research in information processing psychology involves two main kinds of empirical activity. The first is the conduct of observations and experiments on human behavior in tasks requiring intelligence. The second, very similar to the parallel activity in artificial intelligence, is the programming of symbol systems to model the observed human behavior. The psychological observations and experiments lead to the formulation of hypotheses about the symbolic processes the subjects are using, and these are an important source of the ideas that go into the construction of the programs.

3.) Formal Systems and Series of Computation

A Turing machine consists of two memories: an unbounded tape and a finite state control. The tape holds data, i.e. the famous zeroes and ones. The machine has a very small set of proper operations--read, write, and scan operations--on the tape. The read operation is not a data operation, but provides conditional branching to a control state as a function of the data under the read head. As we all know, this model contains the essentials of all computers, in terms of what they can do, though

other computers with different memories and operations might carry out the same computations with different requirements of space and time.

4.) Consciousness and Controversies

The symbol system hypothesis implies that the symbolic behavior of man arises because he has the characteristics of a physical symbol system. Hence, the results of efforts to model human behavior with symbol systems become an important part of the evidence for the hypothesis, and research in artificial intelligence goes on in close collaboration with research in information processing psychology, as it is usually called.

5.) Algorithms and Automota

Before there can be a move generator for a problem, there must be a problem space: a space of symbol structures in which problem situations, including the initial and goal situations, can be represented. Move generators are processes for modifying one situation in the problem space into another.