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Editorial

Theories of Learning in Dynamic Decision Making

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DESCRIPTION

Dynamic decision-making (DDM) is interdependent decision-making that takes place in an environment that changes over time either due to the previous actions of the decision maker or due to events that are outside of the control of the decision maker. In this sense, dynamic decisions, unlike simple and conventional one-time decisions, are typically more complex and occur in real-time and involve observing the extent to which people are able to use their experience to control a particular complex system, including the types of experience that lead to better decisions over time.

Examples of dynamic decision making situations include managing climate change, factory production and inventory, air traffic control, fire fighting, and driving a car, military command and control in a battle field. Research in DDM has focused on investigating the extent to which decision makers use their experience to control a particular system; the factors that underlie the acquisition and use of experience in making decisions; and the type of experiences that lead to better decisions in dynamic tasks.

THEORIES

Strategy-based learning theory

One theory of learning relies on the use of strategies or rules of action that relate to a particular task. These rules specify the conditions under which a certain rule or strategy will apply. These rules are of the form if you recognize situation S, then carry out action/strategy A. For example, Anzai implemented a set of production rules or strategies which performed the DDM task of steering a ship through a certain set of gates. The Anzai strategies did reasonably well to mimic the performance on the task by human participants.

Connectionism learning theory

Some other researchers have suggested that learning in DDM tasks can be explained by a connectionist theory or connectionism. The connections between units, whose strength or weighing depend upon previous experience. Thus, the output of a given unit depends upon the output of the previous unit weighted by the strength of the connection. As an example, Gibson et al. has shown that a connectionist neural network machine learning model does a good job to explain human behavior in the Berry and Broadbent's Sugar Production Factory task.

Instance-based learning theory

The Instance-Based Learning Theory (IBLT) is a theory of how humans make decisions in dynamic tasks developed by Cleotilde Gonzalez, Christian Lebiere, and Javier Lerch. The theory has been extended to two different paradigms of dynamic tasks, called sampling and repeated-choice, by Cleotilde Gonzalez and Varun Dutt. Gonzalez and Dutt have shown that in these dynamic tasks, IBLT provides the best explanation of human behavior and performs better than many other competing models and approaches. According to IBLT, individuals rely on their accumulated experience to make decisions by retrieving past solutions to similar situations stored in memory. Thus, decision accuracy can only improve gradually and through interaction with similar situations.

Necessity is typically determined by the decision maker's "aspiration level," similar to Simon and March's satisficing strategy. But the necessity level might also be determined by external environmental factors like time constraints. Once that necessity level is crossed, the decision involving the instance with the highest utility is made. The outcome of the decision, when received, is then used to update the utility of the instance that was used to make the decision in the first place. This generic decision making process is assumed to apply to any dynamic decision making situation, when decisions are made from experience.

The computational representation of IBLT relies on several learning mechanisms proposed by a generic theory of cognition, ACT-R. Currently, there are many decision tasks that have been implemented in the IBLT that reproduces and explains human behavior accurately.

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