EMERGENT BEHAVIOR

Learning General Knowledge by Utilization of Local Information and Acquisition and Utilization of Widely Available Knowledge

This research group deals with following two topics:

(1) **Reinforcement Learning in Partially Observable Environment by Autonomous State Segmentation**

In former studies in robot learning, methods for distinguishing states in behavior learning is given by the designer dependently on a specific problem domain. However, It is possible to realize more general learning methodology independent on problem domains by introducing an architecture in which the robot autonomously distinguishes states based only on local information acquired by its own sensors. Concretely, it recognizes states based on real sensor inputs and, in order to deal with perceptual aliasing problem caused by locality of the inputs, it utilizes short-term memory as a clue of state distinction. Moreover, autonomous state recognition corresponding to the problem domain is realized by autonomous segmentation of the state-space. Fig.1 shows the proposed state-space representation with decision-tree structure.

(2) **Acceleration of Reinforcement Learning by Acquisition and Utilization of Generalized Rules**

In former robot-learning studies, the purpose of learning is limited to a behavior acquisition for a specific problem. In this group, we focus on "development" of a robot from the perspective of ontogenetic time-scale and propose an approach that acquires and utilizes more generally applicable knowledge based on experience acquired through multiple learning processes. Concretely, the robot extracts state-action pairs that hams task execution commonly in multiple learning processes as "generalized rules," and, if same situation is observed after this, corresponding action is inhibited. Learning processes are accelerated by this inhibition. Thus, the robot can accumulate general knowledge through iteration of learning processes. Fig.2 shows a schematic view of the proposed learning architecture. In this system, we add a module to manage generalized rules over an architecture to realize individual learning.

Now we are dealing with synthesis of these two methodology.

Keywords: Reinforcement Learning, Partially Observable Markov Decision Process, Autonomous State-Space Segmentation, Generalization,

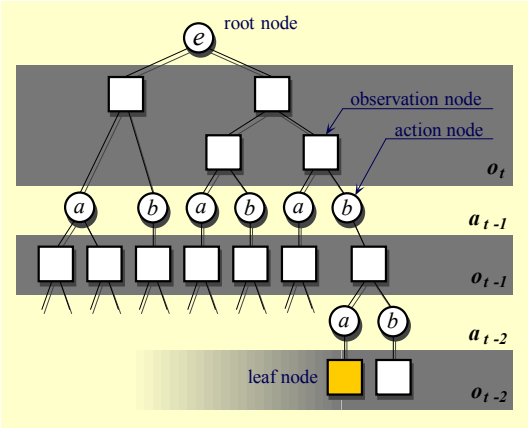

Fig.1 State-representation

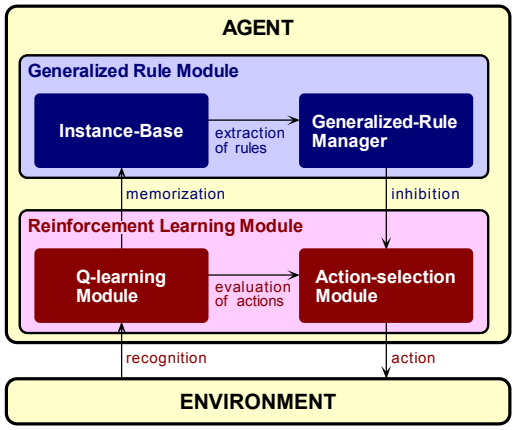

Fig.2 System architecture