1 Research Review

In the history of AI planning, STRIPS (Stanford Research Institute Problem Solver) can be considered as the first automated planning system introduced by Richard Fikes and Nils Nilsson in 1971 [1]. In STRIPS, a state (i.e., initial, goal, etc) comprises state variables which values can be either with True or False. In addition, a action that allow transitions between states is composed of three sets of state variables *PRECONDITIONS*, *ADD*, and *DELETE*. *PRECONDITIONS* is employed to determine whether an action is applicable to a state, and *ADD* as well as *DELETE* are used to present the effects on a state after taking the action. Such presentation proposed with STRIPS has a significant influence in the AI planning research. After years of study, researchers realized that STRIPS is not enough for problems in real domains, therefore, ADL (Action Description Language) is introduced to relaxed some of the restrictions of STRIPS that enables disjunction, negation, and quantifiers [2]. Later, PDDL (the Problem Domain Description Language) [3] was presented as a standardize syntax for STRIPS, ADL and other languages.

With the state and action presentations, different search approaches can be levered to identify a feasible plan to reach the goal state from the initial states, including forward state-space search and backward state-space search which can further employ good heuristic functions to facilitate the searching process. However, plan exploration with forward and backward state-space search approaches only allows strictly linear sequences of actions, which cannot leverage the advantage of problem decomposition. To resolve the issue, partial-order planning is proposed to permit problem decomposition by computing and merging subplans for subgoals! [4]. To enable the interleaving of actions between subplans of different subgoals within a single sequence, methods such as WARPLAN [5] and INTERPLAN [6].

After 20 years of domination of partial-order planning, graph planning systems [7] which are much faster than the partial-order planners in that era have become popular. In GRAPHPLAN system, a special data structure is proposed to develop a graph which contains interwoven states and action levels. In addition, other popular method, named SATplan (Planning as Satisfiability) is also introduced that converts planning problem into a boolean satisfiability problem [8]. Furthermore, another representation of plans, binary decision diagrams, was also discussed [9, 10].

References

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