Historical Developments in AI Planning
Short Review

In this short review, we explore the major historical developments which occurred in the field of AI planning. Three major milestones along with their interrelationship which led to current planning research are analyzed in brief. The first major work pertaining to AI Planning was STRIPS (Stanford Research Institute Problem Solver) designed by Fikes and Nilsson, 1971 [1]. STRIPS is a member of the class of problem solvers that search a space of "world models" to find one in which a given goal is achieved [2]. A "world model" would consist of a set of applicable operators which could transform the state of the problem from one state to another. Thus the task of STRIPS is to find some composition of operators that transform a given initial world model into one that satisfies some stated goal conditions [2].

In STRIPS, a world model is represented by a set of well-formed formulas (wffs) of the first-order predicate calculus [2]. This type of representation language created for STRIPS has been most influential [1], the currently extensively used PDDL (Planning Domain Definition language) is very closely related to STRIPS representational scheme. This idea of general purpose way of describing the problem declaratively - by specifying initial world state, Operators - its preconditions and effects on the world state and the goal state declaration, is taken from STRIPS itself.

Although, the representational ideas of STRIPS were very useful and powerful, it lacked in its algorithmic approach which followed what is now called linear planning approach. It was not able to efficiently solve very simple problems such as Sussman anomaly found by Allen Brown [1]. Thus, new efficient search techniques were needed. Avrim Blum and Merrick Furst (1995, 1997) revitalized the field of planning with their GRAPHPLAN system, which was orders of magnitude faster than the partial - order planners of that time [1] and also mitigated the disadvantages of linear planning systems such as STRIPS. GRAPHPLAN, which plans in STRIPS-like domains, uses the strategy in which rather than immediately embarking upon a search as in standard planning methods, the algorithm instead begins by explicitly constructing a compact structure called a Planning Graph and then uses this generated Planning Graph to guide the search of a plan [3]. Graphplan's algorithm is sound and complete: any plan the algorithm finds is a legal plan, and if there exists a legal plan then GRAPHPLAN will find one [3]. The tremendous improvement in efficiency due to GRAPHPLAN and also its termination guarantee made GRAPHPLAN a huge milestone in the development of AI planning, the concepts of which are still used in present planners.

Bonet and Geffner's Heuristic Search Planner (HSP) and its later derivatives (Haslum et al., 2005; Haslum, 2006) were the first to make state-space search practical for large planning problems [1]. In HSP, the search is assumed to be similar to the search in problems like the 8-Puzzle, but in planning unlike the 8-puzzle, heuristic is extracted automatically from the declarative representation of the problem [4]. HSP thus appeals to a simple scheme for computing the heuristic from Strips encoding and uses the heuristic to guide the search for the goal [4].

As far as the comparison of planning approaches is concerned, Helmert (2001) analyzed several classes of planning problems, and showed that constraint based approaches such as GRAPHPLAN are best for NP-Hard domains, while search based (like HSP) do better in domains where feasible solutions can be found without backtracking [1]. In this way, the three milestone developments - STRIPS, GRAPHPLAN and HSP paved the way in creation of effective planning strategies of today.

References

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