# Research review

Planning research is critical to the field of Artificial Intelligence. Planning is the center of decision making of robots or automated agents. The following article describes a few historical developments in the field of AI Planning and search.

STRIPS(Fikes and Nelson, 1971) was the first major planning system. It was developed at SRI International for robot planning problems. It uses propositional logic to allow a robot to reason what logical action needs to be taken at a start state to reach the end state. A STRIPS instance has a set of conditions (propositional variables), a set of operators/actions, an initial set which is the set of conditions that are initially true and a specification of goal state. A plan is simply a sequence of operators that can be executed from the initial state that leads to the goal state. One of the disadvantages of the STRIPS is that the initial state is considered fully known ie., conditions not in the initial state are assumed false. This is a limiting assumption as there are natural examples of planning problems where the initial state is not fully known. There are some extensions of STRIPS to deal with this case.

GRAPHPLAN (A. Blum and M. Furst, 1997) automated planning algorithm was a major development in AI planning history. It was orders of magnitude faster than the partial-order planners of that time. It takes in the planning problem in STRIPS and creates a sequence of operations for reaching a goal state. The nodes are actions and atomic facts arranged in alternate levels and edges are two types – from an atomic fact to the actions for which it is a condition, from an action to the atomic facts it makes true or false. The algorithm iteratively extends the planning graph looking for actions and previous states from which the goals can be reached and pruning as many nodes as possible.

SATPlan is another automated planning method developed by H.A Kautz and B. Selman, 1992. Given a problem instance in planning, with a given initial state, a given set of actions, a goal, and a horizon length, a formula is generated so that the formula is satisfiable if and only if there is a plan with the given horizon length. A plan can be found by testing the satisfiability of the formulas for different horizon lengths. The simplest way of doing this is to go through horizon lengths sequentially, 0, 1, 2, etc.

Constraint-based approaches such as GRAPHPLAN and SATPlan are best for NP hard domains which search based approaches do better in domains where feasible solutions can be found without backtracking. GRAPHPLAN and SATPlan don't do well in domains with many objects because of too many actions.

References:

Richard E. Fikes, Nils J. Nilsson. "STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving", (Winter 1971)

A. Blum and M. Furst, "Fast Planning Through Planning Graph Analysis", Artificial Intelligence, 90:281–300 (1997).

H. A. Kautz and B. Selman, "Planning as satisfiability". In Proceedings of the Tenth European Conference on Artificial Intelligence (ECAI'92), pages 359-363, (1992)