

Project 3 Research Review

Historical developments in the field of AI planning and search

Considering its major influence in the field of description languages for state-space search problems, the STRIPS (Fikes and Nilsson, 1971) problem solver is one of the initial advances in AI planning. STRIPS, which stands for "Stanford Research Institute Problem Solver", is a problem-solving program built by Richard Fikes and Nils Nilsson in 1971. STRIPS has been used primarily to solve problems faced by robots (specifically, Shakey from SRI): re-arranging objects, navigating. In order to model the real world, STRIPS represents it by a set of first-order-predicates, specifically an initial state, a definition of a goal state and actions that have preconditions and postconditions. This planning language is the base of subsequent "classical" languages that followed after STRIPS, such as ADL (Pednault, 1986) or PDDL (Ghallab *et al.*, 1998).

This leads us to the main idea behind most of the algorithms used by planners in the early days. This was called "linear programming" due to the linear sequences of actions needed to execute a plan, one step at a time. It turned out that his approach to solving planning problems was incomplete, in the sense of not being able to solve certain classes of problems (Sacerdoti, 1975). Sacerdoti introduces a new way of thinking about planning, using a new information structure called the "procedural net", which describes a plan as a partial ordering of actions with respect to time. This was Sacerdoti's NOAH planner, a problem solver that uses a nonlinear representation of plans. This new way of solving a planning problem was based on a simple idea that a plan may have the structure of a partial ordering. The idea introduced was that a complete planner must allow for interleaving of actions from different subplans within a single sequence.

As described by Waldinger (1975), one solution to the interleaving problem a technique that allowed for conflict avoiding strategies between subgoals. This was called a "goal-regression planning" and was also used by Warren (1974) in the "Warplan" problem solver. Warplan was interesting from the point of view of programming languages advances in regards to AI, since it was the first planner written in Prolog, a logic programming language. This is when it was shown the advantages of logic programming in AI. Therefore, the goal regression planning technique first constructs a totally ordered plan, similar to early approaches, but then it modifies it in order to satisfy all sub-goals. In comparison, Warplan was still creating plans as linear sequences of actions, compared to NOAH, which was non-linear.

References

Fikes, Richard E, and Nils J. Nilsson. 1971. "STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving". *Artificial Intelligence* p189-208
Sacerdoti, Earl D. 1975. "The Nonlinear Nature of Plans".
Waldinger, Richard. 1977. "Achieving Several Goals Simultaneously". *Machine Intelligence*, volume 8, 94-136