Introducing three important historical developments in AI planning

Along with the development of Artificial Intelligence Planning, a lot of new concepts of problem abstraction are invented and implemented into famous planners. These planners we are going to introduce made impact to the industry and some of them even contribute to our modern daily life.

Planner STRIPS

STRIPS (Stanford Research Institute Problem Solver) is an automated planner developed by Richard Fikes and Nils Nilsson in 1971 at SRI International [1]. The description language STRIPS used is composed from states, goals and set of actions. In STRIPS, goals are maintained in a stack and whenever the top goal on the stack matches the current state description, it is eliminated, and any match substitution in the goal is propagated down the stack.

Planner TWEAK

TWEAK is a constraint posting planner [4]. Constraint posting is the process of defining an object (such as a plan) by incrementally specifying partial constraints it must fit. The search space is pruned as constraints are added, until all remaining alternatives satisfy the constraints. This approach minimizes backtracking. TWEAK always has an incomplete plan while working on a problem; this is a partial specification of a plan that may solve the problem. Since it could be solved in many ways it represents a class of complete solutions. A complete plan is a total order on some finite set of plan steps.

Planner NOAH

NOAH (Nets Of Action Hierarchies) is a consultant system that advises a human amateur in a repair task. An advantage of its hierarchical nature is that it can specify abstract plans for trained experts but could provide more explicit details for a novice. NOAH's hierarchy is formed by abstractions of problem-solving operators. It initially plans with generalized operators, and then refines them.

After all, most of these planners were invented to tackle problems that the seniors were not capable of solving. The TWEAK introduced non-linear planning upon STRIP and become a complete planner that allows interleaving of actions. The NOAH introduced heuristic search and hierarchical planning so that the planning process is speed up significantly. Still, planners are not replaceable by new comers. Analysis [5] shows that constraint-based approaches are best for NP-hard domains, while search-based approaches do better in domain where feasible solutions can be found without backtracking.

References:

[1] Richard E. Fikes, Nils J. Nilsson. [STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving]

[2] S. J. Russel and P. Norvig. [Artificial Intelligence: A modern Approach]

[3] Duke Computer Science, [AI Lectures Summary](https://www.cs.duke.edu/brd/Teaching/Previous/AI/Lectures/Summaries/planning.html)

[4] D. Chapman. [Nonlinear Planning: A Rigorous Reconstruction]

[5] M. Helmert. [Complexity results for standard benchmark domains in planning]