AI Planning History: Three Major Developments

STRIPS (Fikes and Nillson, 1971)

STRIPS was the first major planning system illustrating the interaction of state space search, theorem proving, control theory and the practical needs of robotics, scheduling and other domains from which AI planning arose. STRIPS was designed as the planning component for the Shakey robot project at the Stanford Research Institute. It was modeled based on an earlier state space search system that used means end analysis called GPS or General Problem Solver (Newell and Simone, 1961). At its core was the integration of state space heuristic search and resolution theorem proving.

Its representation language was much more influential than its algorithmic approach and is close to what we call "classical" language. The key technical contribution is arguably the "STRIPS assumption": that a plan operator affects only those aspects of the world explicitly mentioned in the operator's addition or deletion lists.

ADL or Action Description Language 1981 relaxed some of the STRIPS restrictions and made it possible to encode more realistic problems. In retrospective, the robot, the environment and the tasks of STRIPS were quite simple by today's standards but they were paradigmatic enough to enable the initial explorations into autonomous intelligent systems. In particular they provided context to the development of A* search algorithm (Hart et al.). STRIPS is often cited as providing the seminal framework for "classical planning" problems. For many years automatic planning was focused on that simple state-space problem formulation and was frequently based on the representation framework and reasoning methods developed by the STRIPS system.

PDDL - The Problem Domain Description Language (Ghallab et al., 1998)

PDDL was introduced as a standardized computer-parsable syntax for representing planning problems and has been used as the standard language for the international planning problems competition since 1998. It was developed by Drew McDermott and colleagues, inspired by STRIPS and ADL. There have been several extensions, the latest PDDL 3.0 includes plan constraints and preferences. NDDL – New Domain Definition Language is NASA's response to PDDL. It uses a timeline/activities rather than propositional/first order logic representation which may be less intuitive but provides more robust execution during critical space missions.

The planning graph and GRAPHPLAN Algorithm

The planning graph, although somewhat complex appeared as very useful in planning. A polynomial size approximation of the exponential tree which represents all possible plan paths. It can be used to provide automatic admissible heuristics and it is the initial stage for the GRAPHPLAN algorithm introduced by Avrim Blum and Merrick Furst (1995, 1997) revitalizing the field of planning being orders of magnitude faster than the partial-order planners of that time. GRAPHPLAN uses the planning graph not just as a source of heuristics but to extract a plan directly from it. GRAPHPLAN algorithm repeatedly adds a level to the graph and once all goals appear as non mutex on the graph it searches for a plan that solves the problem, terminating with failure if there is no solution.