A Report on Developments in AI Planning and Search

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Planning and search in AI is a topic which grew from practical needs like robotics, planning and scheduling. It has been researched since the 1970s, and following have been important developments which made an impact on this domain -

1. PDDL and Strips - STRIPS(**St**anford **R**esearch **I**nstitute **P**roblem **S**olver) (Fikes and Nilsson, 1971) was the planning component of the first major planning system which uses QA3 theorem proving system(Green, 1969b) and as shown by Bylander(1992) is PSPACE complete. But the main impact it had was the action representation it had as most planning systems hence have used some or the other variant of that. This was followed by multiple planning languages till the Problem Domain Description Language or PDDL (Ghallab et al., 1998) was introduced as a computer-parsable, standardized syntax for representing STRIPS and all these other languages. The next step from here was the usage of logic programming languages like Prolog which reduced complexity of code significantly and hence made it possible to encode much more complex problems.

2. Partial Order Planning - Partial order planning fuelled research in AI planning for the next few years. The ideas underlying partial-order planning include the detection of conflicts (Tate, 1975a) and was used in NOAH planner (Sacerdoti, 1975, 1977). Initially, partial order planning was not fully understood till McAllester and Rosenblitt, 1991 came up with the first readable and simple description of complete partial order planning. An implementation of the same called SNLP (Soderland and Weld, 1991) was widely distributed and allowed many researchers to understand and experiment with partial-order planning for the first time.

3. GRAPHPLAN - 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. A planning graph can be used in many different ways to guide the search for a solution. LPG (Gerevini and Serina, 2002), searched planning graphs using a local search technique inspired by WALKSAT. Planning graphs were also used to calculate various heuristics. Nguyen et al. (2001) gave a very thorough analysis of these heuristics which can be derived from planning graphs. Helmert (2001) analyzed several classes of planning problems, and showed that constraint-based approaches, such as GRAPHPLAN are best for NP-Hard domains. GRAPHPLAN can have trouble in domains with many objects, since then it must create many actions but this can be improved by generating the propositionalized actions dynamically, as and when required, rather than instantiating them all before the search begins.