Historical Developments in the field of AI Planning and Search

Research Review - Sebastian Mack

Planning is a central aspect in AI research and has its roots in state-space search, theorem proving, control theory, robotics, scheduling, and other domains. As described in [1], it combines two major areas of AI: logic and search. Planning addresses the problem of controlling the combinatorial explosion (p primitive propositions in a domain result in 2^p states). This report summarizes the historical developments within this field, highlighting the relationships between the developments and their impact on the field of AI as a whole.

In 1971, one of the first planning systems called **STRIPS** (STanford Research Institute Problem Solver) was introduced by Fikes and Nilson [2]. The SRI AI Laboratory was developing an experimental project in which a mobile robot could navigate and push objects around in a multi-room environment [3]. For this purpose, a framework was needed in order to solve the "classical planning problem" with static states and a single agent performing actions. The key technical contribution of STRIPS for these problems was the STRIPS operator representation and the algorithm for modeling the effects of an operator (A plan operator affects only those aspects of the world explicitly mentioned in the operator's deletions and additions lists).

Based on STRIPS and ADL (Action description language) a new standard with the name **PDDL** (The Planning Domain Definition Language) was proposed by the AIPS-98 Planning Competition Committee in 1998. It is described in [4] that PDDL is intended to express the "physics" of a domain, that is, what predicates there are, what actions are possible, what the structure of compound actions is, and what the effects of actions are. The latest version of the language is PDDL3.1 [5] which includes so-called "object-fluents".

Partial-order planning is a sub field that was long time not well understood until the work of Chapman that introduced the planner TWEAK [6] which then lead to other implementations like SNLP and UCPOP.

One of the current achievements (early 2000) in the field of AI planning is Hoffmann's state-space searcher FASTFORWARD or FF, winner of the AIPS 2000 planning competition. Similarily to an HSP (Heuristic Search Planner) system, FF relies on forward search in the state space, guided by a heuristic that estimates goal distances by ignoring delete lists [7]. In addition, the very fast search algorithm combines forward and local search in a novel way.

References

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