AI Planning and Search: historical development

In early 1970s planners generally considered totally ordered action sequence. Computing a subplan for each subgoal and then stringing the subplans together with some order achieved problem decomposition. This approach, called linear planning by Sacerdoti (‘75) and based on notion of serializable subgoals (Korf, ‘87), was soon found to be incomplete. Interleaving of actions from different subplans within a single sequence must be allowed, as shown in Sussman anomaly (Sussman ‘75).

1. Partial order planning (POP)

POP, including the detection of conflicts (Tate, ‘75) and the protection of achieved conditions from interference (Sussman ‘75), dominated in next two decades. The first clear formal exposition was TWEAK (Chapman, ‘87), a planner simple enough to allow proofs of completeness and intractability of various planning problem. Chapman’s work led to a straightforward description of a complete partial-order planner (McAllester and Rosenblitt, ‘91), then to the widely distributed implementations SNLP (Soderland and Weld, ‘91) and UCPOP (Penberthy and Weld, ‘92). POP fell out of favor in late 1990s as faster methods emerged. However Nguyen and Kambhampati (‘01) suggested that with accurate heuristic derived from a planning graph, the POP planner is better than or competitive with GRAPHPLAN and the fastest state-space planners.

2. State space planning

State-space planning was pioneered by Drew McDermott (‘96), first to suggest the ignore-delete-list heuristic. Bonet and Geffner’s Heuristic Search Planner (HSP) and later derivatives (‘99, ‘05, ‘06) were the first to make state-space search practical for large planning problems. The most successful state-state searcher to date is FF (Hoffman et al, ’01, ’05) based on fast forward search. Later adaptations including preprocessing the action schemas (Helmert, ’06) further improved the state-space searcher.

3. Graph planning system

Blum and Furst (’95, ’97) revitalized the filed of planning with GRAPHPLAN, which was orders of magnitude faster than POP of the time. Other graph-planning systems such as IPP (Koehler et al, ’97), STAN (Fox and Long ‘’98), and SGP (Weld et al, ’98), soon followed. A planning graph can be used in many different ways to guide the search for a solution, for example above work by Nguyen and Kambhampati on POP.

The jury is still out on the optimal approach to planning. All these approaches will continue to move the field of AI planning forward together. Impact on the filed of AI: the advance in planning and search is central to AI since its inception. Most recently, it is vital to robot motion (including self-driving car or other automatic machines) planning.