Research Review

Planning and search algorithms are central to artificial intelligence (AI). In many ways the essence of such algorithms are what are behind in intelligence in general. For example, planning graphs and search tress are remarkably similar to life's speciation on Earth. One could easily say that there is an innate algorithm on Earth looking for intelligent life. One day we may extend such analogy to the Cosmos! But before doing that it helps to understand how humans try, with our limited capacity, to final optimal solutions to complex problems without knowing if they have a solution or not. In this short review, I identify three key milestones in the initial history of planning and search in AI: (1) linear planning; (2) goal-regression planning; and (3) partial-order planning.

In the early 1970s, the first major planning system, STRIPS, was developed by Fikes and Nillson [1]. It was based on having an initial state, speciation of goal states, and a set of actions [2]. Thus, the plan is essentially a list of actions that connect an initial state to a goal state(s). However, its simplicity was also a sign of its incompleteness. Early planners like STRIPS were based on linear planning, which essentially is stringing the subplans of subgoals together without testing for interleaving of actions from different subplans [1]. That is, it was not possible to see if subsequent actions made sense in the context of all prior actions instead of just satisfying the current goal state.

To address this issue, goal-regression planning was introduced in the mid-1970s and implemented in WARPLAN, which at the time was the first planner to be written in a logic programming language [1]. Furthermore, it required a mere 100 lines of code and had similar performance to other more complicated planners at the time [1]. A key design intent of goal-regression planning is to avoid conflict between subgoals. By doing so, the choice of subsequent actions accounts for selection of all previous actions and their consequences affecting the current goal state.

Building on this planning momentum, partial-order planning was refined in the mid-1970s and dominated the next 20 years of research [1]. Partial-order planning was able to detect conflicts and protect the achieved conditions from interference [1]. Ultimately, partial-order planning led to capacity of ascertaining the completeness or intractability of various multiple problems, marking a leap in mankind's ability to search a vast and unknown space and determining if a solution exits in the abyss. Incredible! Such developments continued to snowball and eventually led to the re-emphasis in state-space planning with the incorporation of heuristics [1].

Unsurprisingly, our journey towards a more complete theory and engineering of artificial intelligence is paved by planning and search algorithms.

1. Russel and Norvig, Artificial Intelligence: A Modern Approach (2010)
2. Fikes and Nilson, STRIPS: A New Approach to the Application of Theorem and Problem Solving (1971)