RESEARCH REVIEW

Planning and search are central to artificial intelligence and have been an area of research in AI for decades. Planning and search are used in a variety of applications including robotics, scheduling, video games, space mission control, and many others. As we'll see below, the field started with planners capable only of developing linear, sequential plans and progressed to using planners capable of efficiently searching the problem state-space and developing interleaved plans.

The first major planning system was developed in the 70's and is known as STRIPS[1,2] (Stanford Research Institute Problem Solver). STRIPS produces a **linear plan** (sequence of actions) in a **deterministic** world where there is **complete knowledge** about the states and actions. STRIPS was the planning component of the first general-purpose mobile robot known as Shakey and is the foundation for most of today's languages for expressing automated planning problems.

Unfortunately, the linear planning inherent to STRIPS can be confounded by some very simple problems. A more general planner must be able to **interleave plans** form the different subplans that will be ultimately strung together to achieve all the subgoals of a problem. Still around the 70s', the WARPLAN planner addressed the problem of interleaving through a technique called goal-regression planning and was notable for having been written in 100 lines of code. However, it was the NOAH planner[3] that tackled interleaving directly through the innovation of **partial order planning**.

Partial order planning dominated AI until the 1990's until Avrim Blum and Merrick Furst demonstrated that their **GRAPHPLAN**[4] system was orders of magnitude faster than the partial order planners. To accomplish this they introduced a novel data structure known as the **planning graph.** The planning graph cut the amount of search required to discover the solution from searching the state space graph. Planning graphs also proved useful for deriving accurate heuristics to guide search. However, GRAPHPLAN is not a panacea and has trouble in domains a very large number of actions to consider.

Computational capacity both on devices and in the cloud are growing at an amazing pace. The coupling of advancements in hardware and efficient search algorithms is going to lead to very exciting applications of AI in our everyday life.

REFERENCES:

1 STRIPS entry Wikipedia: https://en.wikipedia.org/wiki/STRIPS
2 Richard E. Fikes, Nils J. Nilsson. "STRIPS: A New Approach to the Application of Theorem Proving in Problem Solving" Presented at the 2nd IJCAI, Imperial College, London, England, September 1-3, 1971. (link)
3 Earl D. Sacerdoti. "The Nonlinear Nature of Plans" (link).
4 Avrim L. Blum, Merrick L. Furst. "Fast Planning Through Planning Graph Analysis". (link)