Research review on historical developments in the field of AI planning and search

The three of the important historical developments in the field of artificial intelligence (AI) planning and search were Stanford Research Institute Problem Solver (STRIPS), Nets of Action Hierarchies (NOAH), and Graphplan.

The first important development was the STRIPS, which was an automated planner developed by Richard Fikes and Nils Nilsson in 1971 at SRI International [1]. STRIPS was the first major planning system developed, and was very influential in the development of the planning and search that almost all of the planning system introduced since then uses the STRIPS language. The STRIPS instance is composed of an initial state, the specification of the goal states, and a set of actions which includes both preconditions and post-conditions. Since the introduction of STRIPS, total-order planning (or linear planning) was used in the field of AI, however, total-order planning was discovered to be incomplete by Sacerdoti in his research in 1975 [2].

Sacerdoti highlighted an example that the total-order planning produces non-optimal solutions for a simple problem such as the “Sussman’s Anomaly” problem. In "The nonlinear nature of plans," NOAH was introduced and it was able to easily solve the optimal solution for the “Sussman Anomaly” problem. NOAH was a first non-linear, partial order planner which introduced a notion of plan-space search, and used TOME (Table of Multiple Effects) to detect goal interactions [3]. This new technique of partial order planning was very influential to the AI planning, as partial-order planning dominated the next 20 years of research. However, depending on the planning problem, the partial-order planning did not always return an optimal solution, and the alternate technique was not developed until 1997.

In 1997, Avrim Blum and Merrick Furst revitalized the field of planning and search by introducing Graphplan [4]. As described in “Fast planning through planning graph analysis” by Blum and Furst, Graphplan is an algorithm for automated planning, and always returns a shortest possible partial-order plan, or states that no valid plan exists. Graphplan outperformed the total-order and partial-order planner on a variety of interesting natural and artificial planning problems. Given the revolutionary techniques of the Graphplan, it became one of the best algorithms to solve the planning problems today.

Starting from the introduction of STRIPS in 1971, the AI related to planning and search evolved by decades to find optimal algorithm techniques. STRIPS introduced a general framework in the field of AI planning and search, which is now the base of the planning languages. NOAH expanded the field by introducing a technique which identified optimal solutions to most of the planning problems. Finally, Graphplan was a revolutionary data structure which automated the planning techniques and always returned optimal solutions.

References

1. Richard E. Fikes, Nils J. Nilsson (1971). "STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving."
2. Earl D. Sacerdoti (1975). "The nonlinear nature of plans."
3. Poole, D., Mackworth, A. (2010). “Partial-Order Planning in Artificial Intelligence Foundations of Computational Agents. Cambridge University Press.”
4. A. Blum and M. Furst (1997). "Fast planning through planning graph analysis."