Research Review – Planning and Search Developments

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This research review focuses on important planning and search developments, highlighting the relationship between their developments and impacts on the field of artificial intelligence as a whole.

General Problem Solver (GPS)

The General Problem Solver (GPS)[1] system was one of the first planners that reduced the difference between some state and a goal state. It was a state space planner that operated in the domain of state space problems, specifying an initial state, goals, and a set of operations. It used means-ends analysis to compare what is given with what is desired, and selects a reasonable next action[1]. GPS was able to solve simple problems that could be sufficiently formalized (trigonometry is given as an example), but it would not solve any real-world problems due to the fact that the search was easily lost in the space of possibilities that keeps expanding exponentially[1]. The impact of GPS in the field of artificial intelligence was that it was the basis of future planning algorithms, such as STRIPS.

Stanford Research Institute Problem Solver (STRIPS)

STRIPS, created by Richard E. Fikes and Nils J. Nilsson[2], is a representational language for constructing planning algorithms. Its control structure was modeled on that of the General Problem Solver, and was the planning component of the software for the Shakey robot project at Stanford Research Institute. It was designed to find a sequence of operators in a space of world models to transform a given initial world model into a model in which a given goal formula can be proven to be true. It uses means-ends analysis to guide it to the desired goal-satisfying model. The impact of STRIPS in the field of artificial intelligence was really the representation language it created, which is close to the "classical" language used today[2].

WARPLAN

In the 1970s, planners generally considered totally ordered action sequences. Decomposition of a problem was achieved by computing a subplan for each subgoal, then stringing them together in some order, which was called linear planning[3]. This was learned to be incomplete and the notion of interleaving actions from different subplans within a single sequence was introduced.

WARPLAN, written by David Warren, implements a solution known as goal-regression planning. It is a technique where the steps in a totally ordered plan are reordered so as to avoid conflict between subgoals. WARPLAN was the first planner

to be written in a logic programming language (Prolog), and exemplifies the remarkable economy that can sometimes be gained with logic programming as it is only 100 lines of code[3].

References

1. Newell, A.; Shaw, J.C.; Simon, H.A. (1959). Report on a general problem-solving program. Proceedings of the International Conference on Information Processing. pp. 256–264
2. Richard E. Fikes, Nils J. Nilsson (Winter 1971). "STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving" (PDF). Artificial Intelligence. 2 (3–4): 189–208. doi:10.1016/0004-3702(71)90010-5
3. Stuart J. Russell, Peter Norvig (2010), Artificial Intelligence: A Modern Approach (3rd Edition)