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Research Review
AIND – Planning

Three developments in the history of AI planning and search are: Fikes and Nilsson 1971's robot, Sacerdoti 1975's block world problem solving that confounded the Fikes and Nilsson method, and McDermott 1996's heuristic search of the state space. In the history of AI planning, the "representational language" used in the Fike and Nilsson robot planner is what is now called "the 'classical' language" (Russell Stuart Norvig 393). Sacerdoti's consultation program "pioneered the way" (Russell Stuart Norvig 394) for the non-linear way of thinking about plans. McDermott brought a "resurgence in state-space searching" after "decades of partial ordering planning" (Russell Stuart Norvig 394).

To create a sequence of actions for their robot named Shakey, Fikes and Nilsson "in an ad-hoc way" used their background in logic to represent states in a logical representation (Fikes Nilsson 1993 228). The action schema is a direct ancestor of this representational language. This representation made the implicit assumption that state variables not directly acted upon stayed persistent, sidestepping the issue of the "frame problem". For searching for a solution set, Fike and Nilsson described their "difference" method as a form of "backward chaining" (Fikes Nilsson 1993 229). In their 1971 STRIPS paper, Fikes and Nilsson addressed their motivation and the reason for not hardcoding the solution set (since the solutions were obvious to a human observer). Any hand written instructions were ultimately finite and a robot with dynamic solver is more "intelligent" if it could solve the goals itself.

Sacerdoti showed in Sacerdoti 1975 that the Fikes and Nilsson method could not cope with a block-stacking problem (p. 206). His conclusion was the inherent assumption made by the Fikes and Nilsson method that plans were linear or have a sequential order. This linear assumption was the very problem why it fails in recognizing the order needed to stack blocks. Actions might not have a relationship or might have a precedence relationship, hence the term partial ordering. Sacerdoti used a data structure that looks like an ancestor of the planning graph. He called this data structure a procedural net in which a network of nodes is created is procedurally. Each various node type holds information on actions; it's preconditions; effects; and a representation of state. To reduce the state size, it borrows from STRIPS the assumption about persistent state variables. To lead it to a goal state, the procedural net uses conflict resolutions (what a planning graph would call mutual exclusions) in "critics" that attempts to resolve conflicts in effects and preconditions by imposing an order relation.

In what Russell Stuart Norvig would characterize as frustration with the popularity of partial order planning (p. 394), McDermott devised a state space search. McDermott justified this by stating that the enormity of the state space is not a problem if you can ignore most of it (p. 149). McDermott conducted a normal state space search with an explored set but used a heuristic in which Russell Stuart Norvig stated is the first use of the ignore-delete-list-heuristic (p. 394). The data structure McDermott used was the "same spirit as the planning graph" but where they do forward search, his greedy-regression-match was backward searching (p. 148).

These three developments was born out of necessity, the need to expand solving capability, and born out of bucking popularity. These three, in their own way, contributed to the development of AI planning and search.

References

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