

In the 1970s, the linear planning approach to solve planning problems was discovered to be incomplete and also failed to solve some typical problems like the Susan anomaly. This led to the definition of what a complete planner should do. "Interleaving of actions from different subplans within a single sequence"¹ along with the ideas of conflicts detection and protection from interference were the main ideas of the new type of planners.

In the 1974 WARPLAN by Warren, was introduced as the first planner to be written in a logic programming language. The proposed solution to the interleaving problem was called goal-regression planning, which basically tries to reorder a totally ordered plan so it avoid conflicts between sub goals. Based on this idea, one year later came the Waldinger's plan. The planning algorithm was explained to work like this - "try to achieve the first of the conjunctive sub goals of the problem, and then regress the other sub goals through the solution to a point where their achievement will not violate those already achieved"². Using this algorithm allowed the planner to add new steps one at a time and was also able to generate sub-optimal plans.

The first planner to allow construction of partially ordered plans was created by Sacerdoti in 1975 called NOAH. He invented a new structure, called "procedural net" that represented "a plan as a partial ordering of actions with respect to time"³. This network, representing plans along with a domain specific language called SOUP (Semantics of a Users' Problem), allowed NOAH to create a new plan, starting with a single goal node and expanding upon all relevant SOUP functions. Compared to the earlier planner HACKER, NOAH was based on late commitment, meaning that possible decisions were deferred, while more information was gathered that would eventually narrow the possibilities. By delaying judgment, a problem-solver could achieve a considerable savings in computational effort.

After a 20 years period of spreading the ideas of partial-order planning, in 1985 David Chapman created the TWEAK algorithm as a result of a different implementation of the NOAH planner. As he stated about the previews planners - "planners of the most promising ('nonlinear') sort have been complicated, heuristic, ill-defined AI programs, without clear conditions under which they work". The main idea was to formalize partial-ordering planning and he defined his algorithm as "rigorous mathematical reconstruction of previous nonlinear planners" and as "an implemented, running program". As a proof of his statement, Chapman solved the Sussman anomaly problem, that was unsolvable for the earlier planners. A couple of years later, Russell and Norvig said that his work "led to what arguably the first simple and readable description of a complete partial-order planner," which was incarnated as SNLP. Compared to the Sussman's HACKER planner, which solved problems by improvisation and debugging results in case of a failure, TWEAK did not need any of this debugging techniques as it never introduced same type of bugs as HACKER.

¹Stuart Russel and Peter Norvig, AI: A Modern Approach, edition 3, Chapter 10, Bibliographical and historical notes

² Patrick Doyle, Planning, AI Qual Summary, Stanford University

³ David Chapman, Planning for conjunctive goals 1985, <http://hdl.handle.net/1721.1/6947>