

## Research Review –Historical Developments in AI Planning

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This review shortly describes 3 of historical developments in the field of AI planning and search.

### **WARPLAN program (goal-regression planning)**

In the early 1970s it was common to use LINEAR PLANNING which considers totally ordered action sequences, this approach decomposed the problem by computing a subplan for each subgoal and then stringing the subplans together in some order, but it was discovered to be incomplete because it does not allow for inter-leaving of actions from different subplans within a single sequence.

Warren's (1974) WARPLAN was introducing one solution to the interleaving problem by goal-regression planning, a technique in which steps in a totally ordered plan are reordered so as to avoid conflict between subgoals.

WARPLAN was also the first planner to be written in a logic programming language (Prolog) which helps to reduced code complexity and is using only 100 lines of code.

### **Noah planner (partial-order planning)**

Noah planner was a pioneer in partial-order planning which include the detection of conflicts and the protection of achieved conditions from interference.

NOAH uses procedural nets, There is a net for each level of abstraction in the plan.

At each level in the plan, a table of multiple effects summarizes all the propositions asserted or denied by more than one node in the net. Interaction between subgoals could potentially occur if a proposition's value is changed by more than one node.

NOAH uses critics that watch the table of multiple effects for effects of actions that would jeopardize a plan and detect and fix problems like interaction problems, eliminate redundancies and more.. NOAH is least commitment because it doesn't order subgoals until it is necessary, so it avoiding interacting subgoals when possible.

Anthony Barret and Daniel Weld (1994) have argued in their book that partial-order planning is superior to total-order planning, as it is more adept at finding the quickest path faster and therefore more efficient.

### **TWEAK planner**

TWEAK (Chapman, 1987), is also a Partial-order planning but it was the first clear formal exposition and allow proofs of completeness and intractability of various planning problems, it is capable of solving any nonlinear planning problem.

TWEAK is using Constraint posting, it defining a plan by incrementally specifying partial constraints it must fit. The search space is pruned as constraints are added, until all remaining alternatives satisfy the constraints. And by doing so it minimizes backtracking.

The heart of TWEAK is a polynomial-time algorithm (polynomial in the number of steps in the plan) that computes possible and necessary properties of an incomplete plan.

It has at all times an incomplete plan, initially null, which is an approximation to a plan that solves the problem. The top-level loop of the planner nondeterministically chooses a goal that is not already achieved and uses a procedure which will now describe to make the plan achieve that goal.

- On those historical developments, we can see how we got from linear incomplete planning, then solving the interleaving problem and make it complete, then make planning more efficiently by partial-order planning and then make partial-order planning more clear and with proofs of completeness with tweak planner.

## References

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