Planning Search – Research Review

STRIPS – Stanford Research Institute Problem Solver

STRIPS is a solver which was designed for the purpose of planning in the Shakey robot project at Stanford Research Institute. Its control structure was modelled after the GPS (General Problem Solver, invented by Newell and Simon in 1961). STRIPS is a state space search based system which uses means-end analysis.

STRIPS can work with models containing large number of formulas, it converts a world model into an arbitrary collection of first-order predicate calculus formulas. It consists of a resolution approach based theorem prover which answers questions raised from particular models and it uses means-end analysis to point the models to the goals.

The main reason for STRIPS popularity was the action representation system used in STRIPS, rather than the algorithmic approach it used. STRIPS was a very popular system and almost all planning systems since then have used variants of the STRIPS language.

ADL – Action Description Language

STRIPS had some limitations, the constant increase of variants led to problems in comparisons. This became harder with STRIPS. The ADL which was invented by Pednault in 1986, allowed to describe realistic problems and removed some of the limitations in STRIPS.

Pednault observed that the expressive power of STRIPS was susceptible to being improved by allowing the effects of an operator to be conditional. This is the main idea of ADL-A, which is basically the propositional fragment of the ADL proposed by Pednault, with ADL-B an extension of -A. In the -B extension actions can be described with indirect effects by the introduction of a new kind of propositions: static laws. A third variation of ADL is ADL-C which is like -B, in the sense that its propositions can be classified into static and dynamic laws, but with some more particularities.

TWEAK

TWEAK is a non-linear planner invented by Chapman in 1987. It uses constraint posting as its approach to problem solving. It can solve any nonlinear planning problem. Constraint posting is the process of defining an object (such as 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. This approach minimizes backtracking.

The planning procedure consists of repeatedly choosing a goal and then planning to achieve it. It uses the modal truth criterion to do this; the criterion shows all the ways a proposition could be necessarily true; the procedure chooses one of them and modifies the plan accordingly.

If a set of constraints is inconsistent, TWEAK backtracks. The number of completions of a plan is exponential in its size, so computing whether something is possible or necessary is extremely expensive. 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 (see Modal Truth Criterion, below).

TWEAK always has an incomplete plan while working on a problem; this is a partial specification of a plan that may solve the problem. Since it could be solved in many ways it represents a class of complete solutions. A complete plan is a total order on some finite set of plan steps.

References:

1. Start J. Russel, Peter Norvig, Artificial Intelligence: A Modern Apporach (2nd Edition)
2. Wikipedia
3. http://users.cs.cf.ac.uk/Dave.Marshall/AI2/node126.html