Chris Morse
September 15, 2017

AI Planning Historical Developments

Development 1: STRIPS (1971)

STRIPs (STanford Research Institute Problem Solver) was the first major planning system. In their words "We describe a new problem solver called STRIPS that attempts 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."

Their primary interest was to use this in the class of problems faced by a robot in rearranging objects. It was originally implemented in LISP. A real world model is represented by a set of well-formed formulas of the first-order predicate calculus. STRIPS searches through this space of real world models. The STRIPS language describes actions in terms of their preconditions and effects. STRIPS was designed to be a general-purpose solution for robot tasks and has been foundational for a much broader area of planning research.

Development 2: SAT Plan (1992)

The SAT Plan was developed based on satisfiability rather than the traditional model of deduction. The algorithm translates a planning problem into propositional axioms and applies a satisfiability algorithm to find a model that corresponds to a valid plan. This approach provides a more flexible framework for describing constraints on plans.

Selman et al. used a randomized greedy algorithm GSAT to solve hard random formulas as well as encodings of hard graph-coloring problems. They had impressive results that lead to an attempt to formulate other problems in AI as propositional satisfiability.

Development 3: Planning Graphs (1997)

In 1997, a new approach to planning in STRIPS like domains was created, called a Planning Graph.   The new planner that uses this paradigm was called Graphplan. Rather than immediately searching as in standard planning methods, the algorithm creates a structure called a Planning Graph.

The Planning Graph encodes the problem in a way that constraints become available to reduce the amount of search needed. Planning Graphs can be created quickly (in polynomial time) and in polynomial size.

Bringing it Together

The developments discussed in this article bring together 3 major advancements in the field of AI Planning. The STRIPS formulation gave researchers a general framework for which more advanced languages could be built.   STRIPS provided the framework which allowed both Graphplan and SAT Plan to be developed. The Graphplan and SAT Plan provided new approaches to solving planning problems.   There are enthusiasts for each approach and there is not yet a consensus for which one is best. Each of these approaches have successfully added to the advancements in the field of AI Planning and will be foundational for research to come.

References

STRIPS - http://ai.stanford.edu/~nilsson/OnlinePubs-Nils/PublishedPapers/strips.pdf

SAT Plan - http://www.cs.cornell.edu/selman/papers/pdf/92.ecai.satplan.pdf

Planning Graphs - https://www.cs.cmu.edu/~avrim/Papers/graphplan.pdf