Research Review

Important historical developments in the field of AI planning and search

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STRIPS

Before

Much of the research in artificial intelligence have been focused on problem solving. In this field of AI, problems like puzzles an games can be described using states with a simple matrix or list. For more complex problems, like when the problem to solve is to decide where to move an object or where to navigate with a robot, the world model must include a large number of facts and relations dealing with the position of the robot and the positions and attributes of various objects, open spaces, and boundaries. To deal with such comples problems, implemented a problem-solving system that depended exclusively on formal theorem-proving methods to search for the appropriate seque~ice of operators. While Green's formulation represented a significant step in the development of problem-solvers, it suffered some serious disadvantages connected with the "frame problem " [2] that prevented it from solving nontrivial problems [1].

The new technique

In 1971, Fikes and Nilsson, introducet STRIPS (Standford Research Institute Problem Solving), that surmounted the Green difficulties by separating entirely the process of theorem proving from those of searching through a space of world models [1]. This separation allows us to employ separate strategies for these two activities and thereby improve the overall performance of the system [1]. In general, STRIPS that attempts to find a sequence of operators in a spcce 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. STRIPS represents a world model as an arbitrary collection of first-order predicate calculus formulas and is designed to work with models consisting of large numbers of formulas [1].

The first time STRIPS has been used was to design the planning component of the software for the Shakey robot project at SRI. Its overall control structure was modeled on that of GPS, the General Problem Solver (Newell and Simon, 1961), a state-space search system that used means-ends analysis [3].

The representation language used by STRIPS has been far more influential than its algorithmic approach; what we call the “classical” language is close to what STRIPS used [3].

ADL

Before

When it comes to dealing with the open world, STRIPS assumes that unknown conditions are false and permits only positive literals and conditions.

The new technique

The Action Description Language, or ADL (Pednault, 1986), relaxed some of the STRIPS restrictions and made it possible to encode more realistic problems [3]. In fact, Pednault observed that the expressive power of STRIPS was susceptible to being improved by allowing the effects of an operator to be conditional, so with ADL the unkown conditions can be considered “unknown”, and negative literals and disjunctions are permitted.

In terms of computational efficiency, ADL can be located between STRIPS and the Situation Calculus.[5] Any ADL problem can be translated into a STRIPS instance – however, existing compilation techniques are worst-case exponential.[6]

PDDL

Before

The ADL helped improve the concepts and introduced by STRIPS by relaxing some of the STRIPS conditions [3], but there were a lack of standardization concerning the Artificial Intelligence planning languages.

The new technique

In the 1988, Drew McDermott and his colleagues developed the PDDL (Planning Domain Definition Language), in the attempt to standardize the Artificial Intelligence languages. The Problem Domain Description Language, or PDDL (Ghallab et al., 1998), was introduced as a computer-parsable, standardized syntax for representing planning problems and has been used as the standard language for the International Planning Competition since 1998. There have been several extensions; the most recent version, PDDL 3.0, includes plan constraints and preferences. [3]

References

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