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Research Review

ARTIFICIAL INTELLIGENCE NANO DEGREE, UDACITY

Representational language for search and planning

One of the key points of artificial intelligence is the general absence of representational commitments. This type of research has been able to achieve its goal by building what is called a *general problem solver*, meaning an algorithm that searches for a successful solution to a problem (plan) given well-specified search space. It used Means-Ends Analysis to compare what is given or known with what is desired and select a reasonable next step. While it solved simple problems such as *Towers of Hanoi,* that could be significantly specified, it could not solve any *real world* problems, mainly due to the amount of combinations that caused the search to simply get lost in all possibilities. It basically became computationally unbearable.

This leads to the first approach to planning known as situation calculus. The idea behind it is that (reachable) states are definable in terms of the actions required to reach them. These reachable states are called situations. What is true in a situation can be defined in terms of relations with the situation as an argument. Situation calculus can be seen as a relational version of the feature-based representation of actions. This allows to state that world states have certain properties, but avoids enumerating all of them.

Theorem proving is used to “prove” that a particular sequence of actions, when applied to a situation characterizing the world state, will lead to the desired result. This is fine in theory, although it can become an exponential search in the worst case. Also, resolution theorem proving only finds a proof (plan), and not necessarily a good plan.

The reduction of specific planning problems to a general problem of theorem proving is not as efficient as it may have seemed, to the extent that a problem can be decomposed and solved through individual problems and then putting back together all the solutions obtained, obtaining very often a more efficient planning process. This could be considered an advantage in the construction of a planning algorithm.

The Stanford Research Institute Problem Solver (STRIP) is an automated planning technique that works by executing a domain and problem to find a goal. With STRIPS, you first describe the world. You do this by providing objects, actions, preconditions, and effects. It was used to power a robot named Shakey, a real, actual robot that went around from room to room, and pushed boxes around.

This planner was built so that Shakey could figure out how to achieve goals by going from room to room or pushing boxes around. It worked on a computer running hardly any memory, so they had to make it as efficient as possible.

The current class of planners, like for example PDDL, have essentially grown out from STRIPS. Although the algorithms have been modified, the basic representational scheme has been found to be quite useful.

Sources

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