Research Review: Planning

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Introduction

In this research review, I have choose tree key development in AI planning that show the evolution of how planning problems has been solved over the years. This is not an exhaustive perspective of AI planning problems solutions.

STRIPS

STRIPS was a language created to describe Planning Problems. In fact, the main objective of STRIPS was an algorithm, but the language is more influential than the algorithm.

The world, in STRIPS, is describe as a set of well formed formula (WFF) that using first-order predicate calculus, it can represent a quite complex world model.

It defines the Operators, that are actions routines that changes the world model. When a operator is applied to the world model, it changes the set of well formed formulas. An operator has:

- Name of the operator
- Preconditions
- Effects

A Solution is a set of Operators that change the world until it finds a world that meets the goal.

With the STRIPS language the problem can be elaborate as a input of states, actions and goals, so the algorithm should search in a tree until find the goal.

The STRIPS was based on the General Problem Solver (GPS). GPS was design to solve mathematical problems.

Legacy

Later the language was modified by Action Description Language (ADL) and it influenced the standardized Problem Domain Definition Language. (PDDL)

Graphplan

Graphplan introduces a new type of Graph. This new graph has levels, the first level is related with the propositions, the the second level is all actions that this propositions can accept, then this produce a new level of propositions.

Graphplan also introduces the idea of mutual exclusion between nodes of the search. This is a pruning in the searching graph.

Results

Graphplan presented excellent results. The first reason was that graphplan was implemented in C, and all other algorithms was implemented in Lisp (a compiled program is faster than an interpreted).

But graphplan also can do pruning with Mutual Exclusion, create parallel plannings and memoizing.

HSP: Planning as heuristic search

The idea of search in planning space with a heuristic took time to be explored. Only in the years 2000 that were proposed the HSP.

The HSP was the first Planning algorithm with a heuristic, it uses the heuristic h_{add} guiding a Hill Climbing Search. HSP can solved more problems than the other planners, but often took more time or produced longer plans.

Because HSP was not an optimal planner and it was not complete, it was developed HSP2 replacing Hill Climbing for Best-First Search(BFS). HSP2 is the best algorithm from these family.

Results

The main problem of these algorithms are the estimators. The heuristics h_{add} and h_{max} cannot compete with specialized heuristics and is not better than h_G used in graphplan. Although the heuristics, the algorithm is competitive with all algorithms developed before it.