Research review

By Søren Pedersen, December 2017

Abstract

This document will highlight three major developments in the field of AI planning and search. I have chosen STRIPS, Planning Graph and Heuristic Search Planner.
These will be discussed and their impact on modern AI will be discussed

STRIPS

In 1971, Fikes and Nilsson created the STRIPS[1] planner, which is a problem solver that maps a world into a model in first order predicate calculus. It defines preconditions and goals that can be reached by manipulating the world with defined actions and as such is a framework that can handle general problem solving with a large number of formulas.
It separates the theorem of world model and the problem solver. The role of the problem solver is to find a set of actions that can transform the initial world into a state that fulfills the goals. The problem solver uses direct search methods, like Breadth first search, to find a plan to the goal.

The formulas defined by STRIPS has influenced the planning language and has resulted in the Problem Domain Definition Language, PDDL[2], which is widely used today.

Graphplan

In 1997, Blum and Furst developed the Graphplan[3] algorithm, which improved the search for a plan. It defines an object called a planning graph which creates the world up front by creating a graph which constructs all states, actions and preconditions.
“A Planning Graph encodes the planning problem in such a way that many useful constraints inherent in the problem become explicitly available to reduce the amount of search needed.”[4]
This means that the Graphplan algorithm provides much faster searching than other planners at that time.

This planning graph approach was the forerunner for other planners that optimized further on the idea and works as a base for heuristic searches, which is the next great development.

Planning as heuristic search

In 1998 a contest showed that a Heuristic Search Planner [5] (HSP), could compete with the best Graphplan planners. The HSP planner builds upon a planning graph and extracts some automated heuristics from STRIPS encodings and by doing so it optimizes the search for a

plan. In existing planners at that time, general planners was way behind domain specific heuristic planners. HSP proved it could compete with these.

This means that the same code will be able to process problems from different domains. This is the ultimate goal for AI - to process general problems efficiently.

Conclusion

The ability to find the right and most optimal way to solve a general problem is central to AI and has been since its inception[6]. By handling different problems with the same code, we can solve them easily. It would normally take a lot of effort to implement specific solutions.

Papers on planning are still being produced and conferences held even though it has been over 40 years since the first general problem definition language, STRIPS, was created and the search for an optimal general planner started. This shows that the search is still going on...

[1]: Fikes and Nilsson, 1971: STRIPS: A new approach ...
[2]: Ghallab et al.: PDDL - The Planning Domain Definition Language
[3]: Blum and Furst, 1997: Fast Planning Through Planning Graph Analysis
[4]: Blum and Furst, 1997: Fast Planning Through Planning Graph Analysis, page 1
[5]: Bonet and Geffner, 2000:Planning as heuristic search
[6]: Russel and Norvig: Artificial Intelligence - A Modern Approach, Third edition