



Research Review

DEVELOPMENT OF AI PLANNING AND SEARCH

Roberto Talamas | Artificial Intelligence, Udacity

Introduction

Planning and search have made a significant progress since their inceptions in the 1970s, in terms of efficient and sophistication of the algorithms and their potential use to solve real world problems. In this paper, three different major developments in the field of AI planning and search will be discussed. The three development include STRIPS, GraphPlan and PDDL.

STRIPS

The Stanford Research Institute Problem Solver (STRIPS) is an automated planning technique developed by Richard Fikes and Nils Nilsson in 1971 that works by executing a domain and problem in order to find a goal. The first step in STRIP is to describe the world. The world can be described by providing objects, actions, preconditions and effects [1].

Once a world is described, a problem set can be provided. Similar to the problems found in the planning project, a problem consists of an initial state and goal condition. Given this information, STRIP can search all possible states, starting from the initial one, until it reaches a goal state.

GraphPlan

In 1997, Avrium Blum and Merrick Furst at Carnegie Mellon developed a new approach to planning in STRIPS-like domains [2]. This new method involved analyzing a new object they called a Planning Graph. They developed an algorithm called GraphPlan for automated planning which takes as input a planning problem in STRIPS and outputs a sequence of actions to reach the goal state, if there is one. The name comes from the idea of using a planning graph to reduce the amount of search needed to find a solutions from just exploring the state space graph.

There are a few distinctions when using a GraphPlan's planning graph as opposed to a state space graph. In the state space graph, the nodes are possible states and the edges indicate actions that would lead to a different state. On the other hand, in GraphPlan's the nodes are actions and atomic facts and the edges represent relations between actions and propositions.

Planning Domain Definition Language (PDDL)

PDDL is a language, inspired by STRIPS formulation of planning problems. The goal of PDDL is to provide a simple standardization of the syntax used to express semantics of actions, preconditions and post-conditions to describe the effects of actions. The intention of PDDL is to express the "physics" of domain in terms of what predicates there are, what actions are possible, what the structure of compound actions is, and what the effects of actions are [3].

A PDDL problem is much simpler than the domain. It consists of objects that are associated with a type and a description of the initial state and goal state. Both the initial state and goal state are described as logical expressions by a list of propositions that are true and everything that is not listed is assumed to be false.

PDDL contains STRIPS, ADL and other representational languages which lead to the standardization of planning languages. This standardization made possible events such as the International Planning Competition (IPC). Thanks to one common language, the planning competitions are able to compare the performance of planning systems based on a set number of problems.

References

- [1] STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving by Richard E. Fikes and Nils J. Nilsson
- [2] Fast Planning Through Planning Graph Analysis by Avrim L. Blum and Merrick L. Furst
- [3] PDDL – The Planning Domain Definition Language by Malik Ghallab et al.