Written Analysis **Pedro Felipe Gardeazábal Rodríguez**
Project: Implement Planning Search
Course: AIND - Udacity Date: 02/10/2018

Research Review

STRIPS representation

STRIPS representation language, based on the STRIPS algorithm [1], was very influential in the field of AI because its formulation approaches "classical" language [2]. Using sets of well formed formulas, STRIPS requires three entities to define the problem space : first, the initial world model with its actual state; second, a set of operators describing actions in the world (these operators include the preconditions and effects for each action); finally the goal condition to be attained.

Partial-order planning

Planning can be considered as a search process through the plan space and a total-order plan may be defined as an ordered sequence of actions achieving a goal or set of goals from an initial state.

Partial-order, as presented in [3] with the help of the POP algorithm, is based on least commitment planing. This means that partial-order planning doesn't commit to a complete total ordered sequence of actions but instead presents a plan with a partial ordered sequence of actions. The planner only registers an order when it is essential to do so in order to achieve a subgoal without forbidding or undoing another subgoal.

In this formalism a plan is represented by a three tuple where the first element represents the set of actions, the second one the set of ordering constraints over the actions (which actions need to occur first) and finally the third element corresponds to the set of casual links (field structure containing an effect, a pointer to the producing action and a pointer to an action for which this effect is a precondition).

Partial-order planning doesn't search among the whole plan space search and represents an advantage when the order of actions is critical to the plan and as such it can optimally solve the Sussman anomaly [3].

GRAPHPLAN

A GRAPHPLAN search is based on a graph plan, which is a valid plan without the requirement that actions don't interfere at a given time [4]. A graph has two kind of nodes that alternate between levels: proposition levels containing proposition nodes and action levels containing action nodes. The graph starts at a proposition level containing the initial conditions of the problem and from there it evolves into an action level containing possible actions followed then by another proposition node containing possibly true propositions again followed by another action level and so on until the goal is reached. To avoid interference between actions at a given level, the graph plan just registers mutual exclusions to allow all the actions to coexist at the same level.

The advantage of a GRAPHPLAN is that a "Graphplan always returns a shortest possible partial-order plan, or states that no valid plan exists" [4].

References

[1] R. Fikes and N. Nilsson. *STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving*. Artificial Intelligence, v. 2, p.189-208, 1971.

[2] Stuart J. Rusell, Peter Norvig. Section 10 *Artificial Intelligence a Modern Approach*. $3^r d$ Edition. Pearson Education, 2015. 400. Print.

[3] Daniel S. Weld. *An Introduction to Least Commitment Planning*. AI Magazine, v.15 n.4, p.27-61, Winter 1994.

[4] Avrim L. Blum *, Merrick L. Furst. *Fast planning through planning graph analysis*. Artificial Intelligence, v.90 n.1-2, p.281-300, February 1997.