AI Planning Historical Developments

Three major developments in the field of **AI planning research**

1 – Development 1: STRIPS (1971)

2 - Development 2: Planning Graph (1997)

3 - Development 3: Heuristic search Graph (1997)

1 – Development 1: STRIPS (1971)

- The example of this method is Air Cargo problem

2 - Development 2: Planning Graph (1997)

- The example of this method is planning graph

3 - Development 3: Heuristic search Graph (1997)

A - HSP is based on the idea of heuristic search. A heuristic search provides an estimate of the distance to the goal. In domain independent planning, heuristics need to be derived from the representation of actions and goals. A common way to derive a heuristic function is to solve a relaxed version of the problem. The main issue is that often the relaxed problem heuristic computation is NP-hard.

B - The HSP algorithm instead estimates the optimal value of the relaxed problem. The algorithm transforms the problem into a heuristic search by automatically extracting heuristics from the STRIPS encodings.

C - The algorithm works iteratively by generating states by the actions whose preconditions held in the previous state set [3]. Each time an action is applied, a measure *g* is updated, which aims to estimate the number of steps involved in achieving a subgoal. For example, suppose *p* were a subgoal. We initialize *g* to zero and then when an action with preconditions *C = r_1, r_2,...,r_n* is applied, we update *g* as follows:

$$g_s(p) := \min\ [\ g(p)\ ,\ 1 + \sum_{i=1,n} g_s(r_i)\ ]$$

$$g_s(p) \stackrel{\text{def}}{=} \begin{cases} 0 & \text{if } p \in s \\ i & \text{if } [\min_{C \to p} \sum_{r_i \in C} g_s(r_i)] = i - 1 \\ \infty & \text{otherwise} \end{cases}$$

Where *C—>P* stands for the actions that assert *p* and have preconditions *C = r_1, r_2,...,r_n*. Then if we let *G* be the set of goal states, the final heuristic function would be as follows:

D – If we let *G* be the set of goal states, the final heuristic function would be as follows:

$$h(s) \stackrel{\text{def}}{=} \sum_{p \in G} g_s(p)$$

We assume that all sub goals are independent it may be the case that the heuristic is not admissible: this usually works well in practice. This HSP method is useful because it allows us to generalize a heuristic computation to any general STRIPS problem formulation.