AIND PROJECT 3 Research review - AI Planning Historical Developments

1. **STRIPS (1971, Rechard Fikes and Nils Nilsson)**

'STRIPS' stands for **ST**anford **R**esearch **I**nstitute **P**roblem **S**olver. The model attempts to find a sequence of operators in a space of world models to transform the initial world model into a model in which the goal state exists. It attempts to **model the world as a set of first-order predicate formulas** and is designed to work with models consisting of a large number of formulas.
In our project, implementation process in 'my_air_cargo_problems.py' was STRIPS formulation. STRIPS assume that there exists a set of applicable operators which transform the world model into some other world model. The task of the problem solver is to find a sequence of operators which transform the given initial problem into one that satisfies the goal conditions. Operators are the basic elements from which a solution is built. Each operator corresponds to an action routine whose execution causes the agent to take certain actions. In STRIPS, the process of theorem proving and searching are separated through a space of world models. **It makes planning as a specific sub-field of AI.**

2. **Graphplan (1997, Avrium Blum and Merrick Furst)**

Graphplan **constructs and searches a compact reachability analysis of the problem state space**. It searches for a plan in two stages. The first stage is the **construction of a data structure, the *plan graph***, that efficiently represents information about what the executive could possibly achieve by executing actions from the initial state. The second stage searches, backwards from the goals, for a substructure within the plan graph that represents a subset of actions that will achieve the goals. The important information that is captured within the plan graph is the collection of propositions that *could*, individually, be made true after application of increasing numbers of actions. In addition, the graph shows which pairs of propositions are mutually incompatible. That is, pairs of facts that cannot both be made true in a reachable state of the world. Once all the facts that form the goal set for the planning problem appear in the graph and are pairwise compatible, the search phase commences. The success of Graphplan led to **the development of a number of Graphplan re-implementations and extensions** and **some of its contributions remain very important today.**
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3. Heuristic Search Planning (1996, McDermott / 1997, Geffner, and Bonet)

Using **heuristic search was not new in planning**. However, **it had not previously seemed very promising**. The difficulties that had been encountered by earlier planners attempting to exploit heuristic choice arose from the fact that the heuristic function was usually encoded by hand and it was often difficult to construct a function that could reliably guide the planner to make all the right choices. The **novel contribution** made by McDermott and by Geffner and Bonet was to demonstrate a method by which a surprisingly informative **heuristic function could be constructed *automatically***, simply by analyzing the domain. The heuristic value of a choice of action is based on an estimate of **how much work remains to be accomplished** following the addition of that action to the plan. To estimate the outstanding work a very simple, yet very effective, measurement is made: the number of actions required to achieve all the outstanding goals *if the destructive effects of those actions are ignored*. **Achieving goals using actions whose destructive effects are ignored is called *relaxed planning***. This HSP method is useful because it allows us to generalize a heuristic computation to any general STRIPS problem formulation.

- **References**

Ryan Shrott, https://towardsdatascience.com/ai-planning-historical-developments-edcd9f24c991

Progress in AI Planning Research and Applications, *Derek Long and Maria Fox*