

Project 3 - Research Review

- Development 1: STRIPS (1971)
 - In 1971, Richard Fikes and Nils Nilsson at Stanford Research Institute developed a new approach to problem solving. They named it STRIPS (Stanford Research Institute Problem Solver) and is composed of an initial state, the goal states and a set of actions. Each action includes preconditions that have to be met before the action is performed, as well as the effects of the action. The idea is to "find a sequence of operators in a space of world models to transform a given initial world model into a model in which a given goal formula can be proven to be true" [1]. For example, supposed we have an air cargo planning problem where the initial state is cargo 1 at SFO, cargo 2 at JFK, plane 1 at SFO and plane 2 at JFK. The goal state we want to achieve is to have cargo 1 at JFK and cargo 2 at SFO. The actions include load a cargo to a plane, unloading a cargo from a plane, and flying a plane from one airport to another. Using search algorithms, STRIPS tells us the optimal plan to achieve the goal state is: Load(C2, P2, JFK), Load(C1, P1, SFO), Fly(P2, JFK, SFO), Unload(C2, P2, SFO), Fly(P1, SFO, JFK), Unload(C1, P1, JFK).
 - Reference:
- Development 2: Planning Graphs (1997)
 - In 1997, Avrium Blum and Merrick Furst at Carnegie Mellon introduced a new approach to planning in STRIPS-like domains, which is based on constructing and analyzing a compact structure called a Planning Graph [2]. A planning graph formulates the problem using a graphical representation where the nodes correspond to the states in STRIPS, while the edges correspond to the actions. The edges connect 2 nodes, representing the before and after effects of the action on the state. They developed a new planner called Graphplan that uses this paradigm. They conducted experiments to prove that Graphplan outperforms several other planners. Furthermore, they gave empirical evidence that the plans produced by Graphplan are quite sensible. The Planning Graph approach provided a revolutionary data structure which gave a whole new perspective on optimal planning techniques.
 - Reference:
- Development 3: Heuristic Search Planner (HSP) (1998)
 - In 1998, heuristic search planner (HSP) algorithm was developed to provide an automated approach to determining heuristics for planning problems. HSP is based on the idea of heuristic search, which provides an estimated distance to the goal. In domain specific tasks, the heuristics are given. However, in domain independent planning require heuristics to be derived, and a common way to do it is by relaxing the constraints. The HSP algorithm instead automatically extracts heuristics from the STRIPS encoding by estimating the optimal value of the relaxed problem [3]. This is another step forward in the field of AI planning.
- Reference:
 - [1] <http://ai.stanford.edu/~nilsson/OnlinePubs-Nils/PublishedPapers/strips.pdf>
 - [2] <https://www.cs.cmu.edu/~avrim/Papers/graphplan.pdf>
 - [3] <https://bonetblai.github.io/reports/aips98-competition.pdf>