

AI Planning and Search – Research Review

STRIPS (1971)

This was what the AIND planning exercise in `my_air_cargo_problems.py` was based on. STRIPS was first developed by Richard Fikes and Nils Nilsson at Stanford Research Institute. The process tried to find a sequence of operators to transform the initial world model into a model in which the goal state exists. The search process was often greedy. STRIPS could leverage breadth first, depth first, as well as A* search algorithms and many of their derivations to complete the goal planning/search task.

Planning Graphs (1997)

Using the STRIPS-like domains, Avrium Blum and Merrick Furst developed a new approach in 1997. They were able to obtain solutions to the planning problem using a Planning Graph construct. The idea was that rather than searching greedily, the Planning Graph object was created, where useful constraints were explicit, thereby reducing the computation of the planning/search effort. Instead of searching in exponential time/effort, Planning Graphs were polynomial. Another benefit to Planning Graphs was heuristic estimation. It could easily identify the cost/levels that the algorithm needed to reach the goals.

Heuristic Search Planner (1998)

Heuristic Search Planner (HSP) was based on the Planning Graphs/heuristic approach, where the HSP could provide an estimate of the distance/effort to the goal. The algorithm could then select the shortest distance/effort. This is often accomplished by performing estimation on the relaxed problem, where preconditions may be ignored. I think we also tried to implement this algorithm in `my_air_cargo_problems.py`.

Summary

The STRIPS formulation gave AI researchers a general framework to define the problem (initialize states, actions, and goals). The Planning Graph gave us additional clues into the relationships between states and actions, and how to optimize the search process. In addition, Planning Graph gave us a glimpse into heuristics and how to best utilize them. The HSP gave us an automated approach for determining heuristics to general planning problems, which further optimize the planning/search efforts at hand.

Blog Post

AI Planning Historical Developments: <https://towardsdatascience.com/ai-planning-historical-developments-edcd9f24c991> by Ryan Shrott

Papers

STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving:

<http://ai.stanford.edu/~nilsson/OnlinePubs-Nils/PublishedPapers/strips.pdf> by Richard Fikes and Nils Nilsson

Fast Planning Through Planning Graph Analysis:

<https://www.cs.cmu.edu/~avrim/Papers/graphplan.pdf> by Avrim Blum and Merrick Furst

HSP: Heuristic Search Planner: <https://bonetblai.github.io/reports/aips98-competition.pdf>, AIPS98 Competition