Historical Developments in Planning and Search for AI

Planning is known to be about the decision making performed when trying to achieve some goal. It involves choosing a sequence of actions that will (with a high likelihood) transform the state of the world, step by step, so that it will satisfy the goal. The world is typically viewed to consist of states, and actions make some variables true and some false reaching another state.

STRIPS

In 1971, A theorem was introduced called STRIPS (Stanford Research Institute Problem Solver) and this theorem was used to search a space of "world models" to find one in which a given goal is achieved. This theorem stated that that for any world model, there exists a set of applicable operators, each of which transforms the world model to some other world model.

Graphplan

After this Graphplan theory was created "a general purpose planner for STRIPS style domains, based on ideas used in graph algorithms." Given a problem statement, Graphplan explicitly constructs and annotates a compact structure called a Planning Graph, in which a plan is a kind of "flow" of truth-values through the graph.

As time went on, improvements to STRIPS were made, in particular the attempt at standardizing AI planning languages with PDDL (Planning Domain Definition Language) where we examine what actions are possible, what the structure of compound actions is, and what the effects of actions are.

Probabilistic Planning

The previous theories worked quite well for classical planning, in particular deterministic and observable state spaces, there soon began a need for novel solutions to non-deterministic problems.

According to AAAI (Association For The Advancement Of Artificial Intelligence) the classic paper Monte Carlo Localization: Efficient Position Estimation for Mobile Robots from 1999 provides one such advancement in solving the non-deterministic problem of robot localization by the application of probabilistic state estimation using Monte Carlo Localization.

This paper provides a memory and computation efficient algorithm which utilizes random sampling to represent a robots belief state. By allowing for faster sampling MCL can incorporate more frequent sensor data which results in higher accuracy.

References:

1. A brief overview of AI planning
2. STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving
3. A Formal Basis for the Heuristic Determination of Minimum Cost Paths
4. SRI International - Timeline of Innovation
5. Graphplan home page
6. Plan compilation
7. The Planning Domain Definition Language
8. PDDL Background
9. AAAI Classic Paper Award
10. Monte Carlo Localization: Efficient Position Estimation for Mobile Robots