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Research summary: History of Planning Algorithms

I am a little perplexed by the nature of this assignment but I'm going to take it to mean that the course authors were looking for a brief history of planning research up until this point.

The earliest planning systems proved to be incomplete, which means that they could not solve certain types of problems. The main problem was with planners that were not able to handle interleaving situations. These are best shown with something called the Sussman anomaly [G.J. Sussman (1975) *A Computer Model of Skill Acquisition]*. The problem is very simple on its face. A stack of blocks are on a table. C sits on top of A, B is by itself. The goal is to get A to sit on top of B and B on top of C, so that the blocks make ABC from top to bottom.

Many early planners would separate these goals into subgoals. But, but pursuing the goals one at a time without looking how completing one goal affected another, the planner would constantly undo its own work.

One of the early solutions to these problems was taking a problem backwards from the goal. These programs proved complete, but many problems are not efficiently solved through backwards planning.

The initial work to come out from Sussman's paper were partial order planners. These leave the order of actions as open as possible, given the problems Sussman demonstrated with linear planners. They prevent work done by one set of processes from being undone by another set of processes. When partial solutions are found they are kept and can potentially be combined with other partial solutions as long as one does not undo the work of the other.

These exhibit the Principle of Least Commitment and do not sequence actions till a full solution is possible [D.S. Weld (1994) An Introduction to Least Commitment Planning]. Partial-order planners came to monopolize research in the field for many years and the previously mentioned author Weld and Soderland distributed the SNLP implementation which allowed efficient implementation of Partial order planning to hard problems.

The next major advancement in planning came through what's called state space planning. These work by defining what parts of the entire universe of state spaces that an algorithm will search and which order to search them in. This is largely accomplished by using algorithms to determine the best heuristics to use to narrow the search space.

These are the types of algorithms that we are using within our own planner to determine best solutions. This approach was pioneered by B Bonet & H Geffner (1999) Planning as Heuristic Search: New Results. The initial planner proposed worked in the forward direction but this was quickly expanded to backward searches. These algorithms have gotten more efficient. That said, since our text was printed in 2010 I tried to get more recent examples of planning research.

It seems that most of the recent work in planning has been in working with problems where the environment and the effects of actions are only known in a probabilistic way, called Markov decision processes and Partially observed Markov decision processes. Planning around user preferences (such as scheduling employees) has also been a fertile field of research.