AI Planning & Search

Developments in the Field

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In the following research, we are going to analyse three developments in the field of planning and search for Artificial Intelligence.

Planning with ordered binary decision diagrams

Ordered binary decision diagrams have been extensively used in computer aided verification, especially in symbolic model-checking. They work in a way where you determine some properties and check if they are correct or not throughout time. As we've seen, we can make an AI go through graphs, but when the decision tree gets too big, it is time to find alternative solutions.

Ordered binary decision diagrams provide an efficient representation of Boolean functions. Two OBDDs are logically equivalent if they are the same OBDD. The negation of an OBDD and the conjunction and disjunction of two OBDDs can be computed relatively efficiently. This is based on a ternary conditional operator (if this then, else then).

Even though OBDDs are often efficient, in more complex applications their size and memory requirements become prohibitively high, and this is their main drawback.

Goal Oriented Action Planning (GOAP)

Goal Oriented action planning refers to a system for agents that are able to plan a sequence of actions to satisfy a particular goal. Both the goal and the current state of the world are taken into account. Each agent can perform a determined number of actions and these are given a cost (we are looking for the lowest possible cost). Actions also have preconditions and effects. Preconditions are states required for a certain action and the effects are the new state after the action has been performed. As we can see, it has many similarities with our Cargo example and the theory seen so far.
GOAP is used a lot in video games for the enemies or computer players as it has a finite amount of actions they can perform and with the same initial conditions, the output can be completely different from one case to another. It is usually combined in Finite-State Machines.

Partial-Order Planning Algorithms

In this algorithm there are several aspects involved that must be taken into account. The first one are the steps that must be taken to reach a goal. We also have ordering constraints that determine which steps must be taken before another step can be done. Variable binding constraints specify which variables are equal to other variables or constants. And finally, we have causal links that link to the effects each action produces.
The algorithm starts with 2 dummy steps (start & finish). Start has the initial conditions and effects and finish has the goal and its preconditions (what must be done).
Each step must satisfy their preconditions so the algorithm iterates until the plan is complete. In the process, subgoals can be determined to specify steps and causal links are taken into account for the final output.

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