

Planning Systems based on Heuristic Search

Introduction

In this short research review I try to summarize 3 approaches for solving planning problems using heuristic search approach. In this memo I giving examples of the 3 planning approaches: *HSP* [1], *FF Planning System* [2] and *FASTDOWNWARD planning system* [3] that could compete with GRAPHPlan and SATPlan.

Alternatives for GRAPHPlan and SATPlan

GRAPHPlan [4] and SATPlan [5] are commonly known reference points as solutions in the category of state-space planning. GRAPHPlan bases its operation on planning graphs and SATPlan bases its operation on planning as satisfiability (where search problem is represented as Boolean satisfiability problem). These two approaches have heuristic algorithms explicitly defined by authors. There is also a third approach in state-space planning domain which is called heuristic-search planning. In this approach heuristic functions are automatically derived from problem representations (whether it is PDDL or STRIPS).

HSP Planning System

HSP systems are based on a heuristic assuming that action precondition are independent. This heuristic is then used in the context of best-search and hill-climbing search algorithms. In general, HSP is able to resolve more problems than GRAPHPlan and SATPlan but it takes more time for HSP to calculate plans and sometimes plans are not optimal.

FF Planning System

Similarly to HSP, FF relies on forward state space search and it uses goal distances by ignoring delete lists. FF is based on heuristic that doesn't assume that action preconditions are independent. Once the automated strategies are extracted, FF uses hill-climbing search algorithm.

Fast Downward Planning System

Fast Downward system is a progression planner searching state-space in forward direction. Once automated heuristics are extracted from problem representation then Fast Downward system uses best-first approach to calculate the optimal plan. What differs this system from HSP and FF that definition of the problem (defined in PDDL) is translated into a new representation called multivalued planning tasks and then Fast Downward uses hierarchical decompositions of planning tasks to calculate heuristic function called causal graph heuristic. Fast Downward system was published in 2004

Conclusions

In general, heuristic-search planning systems are able to resolve bigger number of problems but are slower in terms of how much time they need to calculate solution and sometimes they don't produce optimal plans.

The fact that is very attractive that heuristics are automatically generated out of problem representation and then further used to calculate best plans using search strategies like best-search or hill-climbing.

References

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