

Three Influential Heuristic Search Planners

Planning as Heuristic Search received a renewed interest around the turn of the century. when UcPOP (McDermott, 1996) formulated planning as heuristic search.

Heuristic Search Planner (HSP) (Bonet & Geffner, 1998) was the first heuristic search-based planner (Liang, 2012) and first competed at the Artificial Intelligence Planning Systems (AIPS) '98 conference. HSP reduced its state-search space by creating a relaxed problem from the original one by ignoring delete lists. It then performed a forward search using a hill-climbing search algorithm with a special, non-admissible yet fairly accurate, heuristic. HSP 2.0 (Bonet, & Geffner, 2001) introduced the h^{add} and h^{max} heuristics which add subgoal costs and find the maximum subgoal cost, respectively, and these are used in newer planners.

FF (Hoffmann, 2001) was a new heuristic search-based planner introduced at the International Planning Competition (IPC) in 2000 and which it won. Like HSP, it worked with a relaxed version of the original problem by ignoring delete lists. For this relaxed problem, it constructed a planning graph using Graphplan (Blum & Furst, 1997). Instead of h^{add} or h^{max} , it offered an improved heuristic h^{FF} which was the length of the (non-optimal) plan extracted from the relaxed planning graph. It also introduced two further improvements which are still used in many planners today (Hoffman, 2012): 1) during search it only expanded those actions contained in the relaxed plan; and 2) it employed a special form of an enforced hill-climbing search to find state with strictly smaller heuristic values.

The IPC 2008 & 2011 Satisficing winner was the LAMA planner (Richter & Westphal, 2010) and was the first to use a heuristic derived from landmarks, propositional formulas that must be true in every solution of a planning task. It used this heuristic together with a variant of

h^{FF} to find both the estimated cost of reach the goal and to find the estimated goal distance (as a measure of remaining search effort) in order to ensure it did not focus too much on finding a cheap plan instead of some plan within a given time limit. Finally it continually restarted the search from the initial state once a solution is found in an effort to find ever better ones.

References

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