Planning – Research Review
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The field of Artificial Intelligence has advanced with extraordinary speed in the past few decades. In particular, the Graphplan (Blum & Furst, 1997) and the stochastic SAT-based planning algorithms (Kautz & Selman, 1992) have offered methods of swiftly solving problems that are orders of magnitude harder than what was solvable in the previous generation of planning systems. For example, the Blackbox planner (Kautz & Selman 1998) required only 6 minutes to find a 105-action logistics plan in a world with 10^{16} possible states. The beauty of Graphplan is, firstly, its simplicity and power in yielding results – in fact, Graphplan guarantees it will find the shortest plan among those in which independent actions may take place at the same time. Secondly, familiarity with Graphplan aids in understanding SAT-based planning systems. Instead of immediately embarking upon a search, Graphplan constructs a planning graph which encodes the problem in such a way that many constraints immediately become available, dramatically reducing the search space. Once the plan graph has been constructed, SATplan extracts a satisfiability problem from the graph and tries to solve it.

Graphplan and SATplan seem to be effective for NP-hard domains, that is, problems that can be solved in nondeterministic polynomial time. However, Helmert (2001) suggested that search-based approaches to planning problems are more performant in domains that do not require backtracking, as Graphplan and SATplan generate a large number of actions to reach the desired goal state.

The late ‘90s saw a resurgence in interest in state-space planning. The most successful automatic planner in the Fifth International Conference on Artificial Intelligence Planning and Scheduling was the FastForward Planning System, devised by Jörg Hoffmann. In this system, planning problems are attacked by forward search in a given state space, guided by a heuristic function that is extracted from the domain description. The planning system relaxes the planning problem by ignoring parts of its specification – more precisely by deleting lists of all actions. This algorithm differed from Bonet, Loerincs, and Geffner’s (1997) HSP system in that it had a better method for heuristic evaluation, and an improved search strategy that helped avoid plateaus and local minima. Starting from a given state, FastForward makes use of Graphplan and then uses the generated output for heuristic evaluation. The advantage of such a system is that plans with fewer numbers of actions are yielded, and it performs egregiously for simple problems. However, as Hoffmann himself notes, FastForward has the potential to lose itself in local minima in problems with a more complicated search-space structure.

Graphplan and SATplan broke historical records for planning speed, and became extremely popular frameworks in the AI world. Neither system appears to be strictly superior to the other – Graphplan works best in some domains and SATplan works best in others. In turn, these paved the way for state-space planning algorithms guided by heuristic functions, such as FastForward, considered to be an advanced successor of HSP. Planning has been central to AI since its inception, and while there is no clear winner amongst the myriad developed algorithms, what is clear is that planning frameworks are developing at a tremendous rate, and previously unsolvable problems are now within the realm of solvability.