Research Review of Recent Algorithms in AI Planning And Search

Introduction:

This paper describes the developments of AI Planning and Search algorithms in terms of size and complexity of problems that can be solved.

1. Planning as Constraint Satisfaction Problem:

- The approach is to look for plans of a given length n that is increased step by step until a plan is found. Advantages of this process includes finding, shortest plans (in terms of points of time) and the descriptions of both the initial and the goal states can be used for effectively inferring fluent values at different time points, thereby reducing exhaustive search.
- As long as the operators do not have contradictory effects and none of the operators falsifies the preconditions of any other, parallel application of operators is possible, and this leads to more efficient planning.
- Search techniques include Graphplan,Translations to Satisfiability algorithm,NP Hard Computational problems, and Specialized Constraint Solver.

2. Declarative Control Information:

- These algorithms work by incrementally making a description of a plan more complete, and they backtrack when it turns out that the current incomplete plan cannot be extended to a full plan and prune the search tree by reducing the number of consecutive backtracking points (the depth of the search tree) and the degree of backtracking points (branching factor). Linear reduction in either yields an exponential reduction in search tree size.
- Techniques include Invariants,Symmetries and Domain-dependent control rules.

3. Domain Independent Distance Heuristics:

- Derive an estimation heuristic function, that assigns to each search state a value indicating how good that state is. Then,during search, favor those states that seem to be best. The difficulty here lies in the derivation of the heuristic.
- Heuristic planners based on ignoring negative effects of all operators have achieved extremely competitive runtime behavior on a lot of the commonly used benchmark planning domains. At the AIPS-2000 planning systems competition, four out of five awarded fully automatic planners were based on this approach.

4. Planning with ordered binary decision diagrams:

- Extensively used in computer-aided verification, especially in symbolic model-checking, that is formal verification of transition systems (a communication protocol, a circuit, a program) with respect to correctness properties. Techniques developed for model checking are therefore directly applicable to AI planning, and vice-versa.
- Model-checking (and AI planning) can be performed by explicitly enumerating the state space and finding transition sequences by algorithms that traverse graphs.

5. Conditional and probabilistic planning:

These algorithms are applied to planning problems involving uncertainty and incomplete information.

References:

An overview of recent algorithms for AI planning : Jussi Rintanen and Jorg Hoffmann
https://pdfs.semanticscholar.org/b089/5a0e741e2e3604a18ebb77df641742bf6077.pdf