AI classical planning algorithms overview

	Graphplan	Boolean Satisf	Heuristic planning
Years of popularity*	1996-2000	1995-present	1999-present
Major concepts and approach	• In a forward phase, build a layered "planning graph" whose "time steps" capture which pairs of actions can achieve which pairs of facts; • in a backward phase, search this graph starting at goals and excluding options proved to not be feasible.	• Is good for to domain-independent planning** • It converts the planning problem instance into an instance of the Boolean satisfiability problem (SAT) • SAT is the problem of determining if there exists an interpretation that satisfies a given Boolean formula	• **Forward search** addresses the problem heuristically by trying to find patterns (subsets of propositions) that cover the independent subproblems. • **Fast downward.** Fast Downward (FD) is a progression planner, searching the space of world states of a planning task in the forward direction. However, the input is first translated into an alternative representation called multi-valued planning tasks, which makes many of the implicit constraints of a propositional planning task explicit.
Impact on AI world	• Due to speed problem, partial ordered approach dominated in 80's and early 90's in AI • it has the disadvantage of not having an explicit representation of states in the state-transition model • Graphplan algoritm works faster than the partial-order planners and after inventing it, it is became possible to use all advantages of totally ordered algorithms and have reasonable time for calulation	• The planners based on SAT win planners based on other search paradigms during win International Planning Competition (IPC) in 2006-2008	• Heuristic approach let to work even when the subproblems are not completely independent. • FD heuristic function, called the causal graph heuristic, unlike traditional HSP-like heuristics doesn't ignore negative interactions of operators and provides better performance for solving AI tasks • Actually this planning approach dominate in AI world: planners win IPC in 2006, 2008 (**fast forward**), 2008, 2011, 2014, 2016 (**fast downward**)
Major works and studies	• A. Blum and M. Furst, "Fast Planning Through Planning Graph Analysis", Artificial Intelligence, 90:281--300 (1997) • Bryce, D., & Kambhampati, S. (2007). A tutorial on planning graph - Based reachability heuristics. AI Magazine, 28(1), 47-83.	• H. Kautz and B. Selman, Pushing the envelope: planning, propositional logic, and stochastic search, AAAI Press, 1996 • Jussi Rintanen. Heuristic planning with SAT: beyond strict depth-first search. Twenty-Third Australasian Joint Conference on Artificial Intelligence, Adelaide, December 7-10, 2010	• Helmert, M. (2006). The fast downward planning system. JAIR, 26, 191–246. • Fast Downward Aidos Jendrik Seipp and al. University of Basel Basel, Switzerland, 2016 (winner of last IPC)

*According to Jorg Hoffmann Wolfgang Wahlster "AI course" 2016 and International Planning competition results
**Rintanen "Planning as Satisfiability" https://users.ics.aalto.fi/rintanen/satplan.html