On the Computational Complexity of Plan Verification, (Bounded) Plan-Optimality Verification, and Bounded Plan Existence

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Introduction •			
Introducti	on		

Objective

We want to study the computational complexity of several problems centered at the bounded plan existence problem.

Problems we are going to study:

- Plan Verification
- Bounded Plan Existence
- (Bounded) Plan Optimality Verification



 Classical (non-hierarchical) planning - Find a sequence of actions (i.e., a plan) that achieves a goal



 Hierarchical planning - Keep decomposing compound tasks until a primitive action sequence is obtained Plan Verification (Complexity Ranges from P to NEXPTIME)

Plan Verification

The plan verification problem is to decide whether a plan is a solution to a planning problem



- It is trivial for classical planning with both the grounded and lifted settings
- It is NP-complete for grounded hierarchical planning
- For lifted hierarchical planning, it is PSPACE-hard (but in NEXPTIME)



Bounded Plan Existence (Complexity Ranges from NP-complete to NEXPTIME-complete)

Bounded Plan Existence

The bounded plan existence problem is to decide whether there exists a solution to a planning problem of length up to a given bound



- Its complexity coincides with the complexity of the plan verification problem
- We can guess and verify a plan up to length k

Introduction Background Plan Verification Bounded Plan Existence Optimality Verification Summary

(Bounded) Optimality Verification

The (bounded) optimality verification problem is to decide whether a plan is a solution to a planning problem and its length is not far from the length of an optimal solution by a given bound



 It is the complement of the bounded plan existence problem with the bound given in unary

			Summary ●
Summary			

	Plan Verification	k-length Plan Existence		Plan Optimality Verification	Bounded Plan Optimality Verification				
		k in binary	k in unary		plan given	only plan length given			
ground	In P	PSPACE-complete	NP-complete	coNP-complete	coNP-complete	PSPACE-complete			
lifted	In P	NEXPTIME-complete	NP-complete	coNP-complete	coNP-complete	coNEXPTIME-complete			
	- Hierarchical Planning								
ground	NP-complete	NEXPTIME-complete	NP-complete	coNP-complete	coNP-complete	coNEXPTIME-complete			
lifted	PSPACE-hard	NEXPTIME-complete	PSPACE-hard	PSPACE-hard	PSPACE-hard	CONEXPTIME-complete			
	In NEXPTIME	HEXT III E-comptore	In NEXPTIME	In coNEXPTIME	In coNEXPTIME				