# On the Computational Complexity of Correcting HTN Domain Models

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- Counter-factual explanations.
  - e.g., why this plan is not a solution?
- Modeling assistance.

Introduction $0 \bullet$		
Overview		

- What if a plan is supposed to be a solution to some planning problem, but it is indeed not?
  - Changing the planning model so that it will be.
- Investigation in HTN planning.
  - Complexity of the problem *wrt* inputs in different forms.
    - Partially ordered plans.
    - Sequential plans.

	HTN Planning ●00	
Illustration		



- A hierarchical approach of planning and modeling.
  - Compound tasks on top of primitive tasks (i.e., *actions*).
  - Keeping refining compound tasks until primitive ones are obtained.
- A set of compound and primitive tasks with partial orders defined over them is called a *task network*.



#### A task network tn is a solution iff

- *tn* is a refinement of the initial task network.
- *tn* possesses an feasible linearisation (NP-complete!).



	HTN Planning 00●	
Solution	Criterion	

# Definition (Hybrid Planning)

A task network tn is a solution iff

- *tn* is a refinement of the initial task network (unchanged).
- Every linearisation of tn is feasible (tractable!).
- Most of our discussion is under this definition in order to remove the ambiguous the hardness source.



- What changes are allowed?
  - Adding and deleting actions from a method.



• Adding and deleting ordering constraints from a method.



		nning Changing 0000	Changing HTN Planning Models ○●○○	
Problem Fo	ormalism:	Provided a Partiall	v Ordered Plan	

Given an HTN planning problem P and a task network tn, we want to decide whether we can transform P into P' by using the operations defined previously so that tn is a solution to P'.

- The complexity of deciding whether such changes exist is depending on the solution criterion.
  - If we demand that at least one linearisation of tn is feasible  $\implies$  NP-complete.
  - If we demand that *every* linearisation of tn is feasible  $\implies$  ?

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		Changing HTN Planning Models ○○●○	
Model Change	Operations:	Provided a Plan and a Method Sec	uence

Given an HTN planning problem P, a method sequence  $\overline{m}$ , and a task network tn, we want to decide whether we can transform P into P' s.t. tn is a solution to P' generated by  $\overline{m}$ .

• We again demand that every linearisation of tn is feasible  $\implies$  NP-complete.

		Changing HTN Planning Models ○00●	
Model Chan	ge Operations:	Provided an Action Sequence	

Given an HTN planning problem P and an action sequence  $\pi$ , we want to decide whether we can transform P into P' s.t.  $\pi$  is a linearisation of a solution to P'.

• We demand that a solution task network requires only one feasible linearisation  $\implies$  NP-complete.

		$\bigcirc$ Conclusion
Summary		

Complexity	Plan	Methods?	Solution
	РО	NO	All
NP-complete	РО	YES	All
	ТО	NO	One

Table: The complexity of changing HTN planning models with regard to user inputs in different forms.