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Problem Formulation

The metalevel search space: The MDP $\langle S, A, T, R, s, t \rangle$

- A set of states $s \in S$.
- A set of actions $a \in A$.
- A transition function $T(s, a, s')$.
- A reward function $R(s)$.
- A start state s .
- A terminal state t .

The state: A state s is an object model consists of a grounded PDDL domain model $\langle P, A \rangle$.

- A set of propositions P .
- A set of actions $a_{EFF}^{PRE} \in A$.
- Each action a_e^p has a set PRE of preconditions and a set EFF of effects.

Working Domain:

Listing 1: LightSwitch Domain

```
:predicates(  
    (switch1_on)  
    (lightbulb_on)  
)  
  
(:action switchon_sw1  
    :parameters ()  
    :precondition (and (not (switch1_on)))  
    :effect (and (switch1_on) (lightbulb_on))  
)  
  
(:action switchoff_sw1  
    :parameters ()  
    :precondition (and (switch1_on))  
    :effect (and (not (switch1_on)) (not (lightbulb_on))  
)
```

State Metaspaces Analysis

Let p be the number of predicates, a be the number of actions.

Each action has a set PRE and EFF of propositions. For each proposition, there are three possible values that it can take on in a concrete instance of the model:

- The proposition can belong to clause as a positive literal.
- The proposition can belong to a clause as a negative literal.
- The proposition can not belong to the clause.

Thus, for each action, there are 3^{2p} possibilities. For all a actions, there are $\prod_1^a 3^{2p} = (3^{2p})^a = 3^{2ap}$ possibilities.

For the example domain, we have $p = 2$ predicates and $a = 2$ actions and $3^{2ap} = 3^{2*2*2} = 3^8 = 6561$ possible domain models.

Action Metaspaces Analysis

Let p be the number of predicates, a be the number of actions. Given a metastate s in the metaspaces S , each proposition can be changed to one of the other two possible values. Thus, there are $4ap$ metaactions.