

Human Reasoning and the Weak Completion Semantics II

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Exercise 3

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Problem 1

Consider a docking terminal for ships which has three blocks, a , b and c placed on a dock, and a robot arm which can help one move these blocks around.

Given an initial state of the world: $ondock(a) \circ ondock(b) \circ on(c, a) \circ clear(b) \circ clear(c) \circ empty$.

The fluent $ondock(X)$ signifies that block X is on the dock, $on(X, Y)$ signifies that block X is on top of Y , $clear(X)$ signifies that the top of block X is clear, $empty$ signifies that the robot's arm is not holding anything and $holding(X)$ signifies that the robot is holding X .

We want to reach the goal state: $ondock(c) \circ on(b, c) \circ on(a, b) \circ clear(a) \circ empty$.

Given the following set of possible actions, $action(preconditions, name, effects)$:

$action(clear(V) \circ ondock(V) \circ empty, pickup(V), holding(V)),$
 $action(clear(V) \circ on(V, W) \circ empty, unstack(V, W), holding(V) \circ clear(W)),$
 $action(holding(V), putdown(V), clear(V) \circ ondock(V) \circ empty),$
 $action(holding(V) \circ clear(W), stack(V, W), on(V, W) \circ clear(V) \circ empty).$

Also given the set of rules:

$causes(X, [], Y) \leftarrow X \approx (Y \circ Z),$
 $causes(X, [V|W], Y) \leftarrow action(P, V, Q) \wedge (P \circ Z) \approx X \wedge causes(Z \circ Q, W, Y),$
 $X \approx X.$

Please answer the following questions:

- Using the above set of actions and rules of inference, starting with

$$causes(ondock(a) \circ ondock(b) \circ on(c, a) \circ clear(b) \circ clear(c) \circ empty, W,$$
$$ondock(c) \circ on(b, c) \circ on(a, b) \circ clear(a) \circ empty),$$

show the next 3 steps of computation. *Recall: $causes(X, W, Y)$ signifies the sequence of actions W which transforms state X to state Y .*

- List the plan or the (grounded) sequence of actions (not to be confused with the *action* predicate) which would transform the given initial state to the desired goal state.
- Suppose that the symbol \circ is idempotent, meaning $X \circ X \approx X$. Using one of the above steps of computation as an example show what would change and what kind of problem could arise.