

# CPT302 Week 4 In-Class Exercises with Solutions

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Q1. What is practical reasoning? What is means - end reasoning? Give examples of them (your own examples please).

Ans: Trivial. Please read the lecture note.

Practical reasoning is reasoning directed towards actions - the process of figuring out what to do.

Means-ends reasoning is the process of deciding how to achieve an end (an intention an agent has) using the available means (the actions agent can perform)

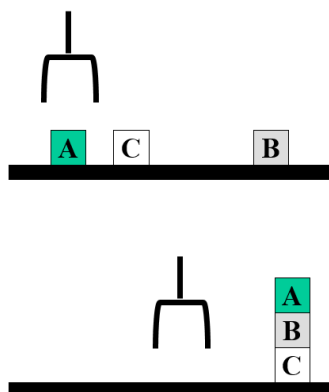
Q2. The Blocks World (BW): Consider the below figure.  
Make a *Plan* to reach the goal from the initial state using some basic actions (*available in the Blocks World*).

Initial state:

clear(a)  
clear(b)  
clear(c)  
ontable(a)  
ontable(b)  
ontable(c)  
handempty

Goal:

on(a,b)  
on(b,c)  
ontable(c)



Ans: A plan can be the following:

A plan:

pickup(b)

stack(b,c)

pickup(a)

stack(a,b)

For the following questions, consider the predicates for describing the Blocks World (BW) and four basic actions / operations that are given in Table 1 and Table 2 respectively.

Table 1: Predicates for Blocks World

Predicate	Meaning
$On(x, y)$	block $x$ is on top of block $y$
$OnTable(x)$	block $x$ is on the table
$Clear(x)$	there is nothing on top of block $x$
$Holding(x)$	robot arm is holding block $x$
$ArmEmpty$	robot arm is not holding any block

Table 2: Stack Operations

Operation	Specification
$Stack(x, y)$	<pre>pre  { <math>Clear(y), Holding(x)</math> } del  { <math>Clear(y), Holding(x)</math> } add  { <math>ArmEmpty, On(x, y)</math> }</pre>
$UnStack(x, y)$	<pre>pre  { <math>On(x, y), Clear(x), ArmEmpty</math> } del  { <math>On(x, y), ArmEmpty</math> } add  { <math>Holding(x), Clear(y)</math> }</pre>
$PickUp(x)$	<pre>pre  { <math>Clear(x), OnTable(x), ArmEmpty</math> } del  { <math>OnTable(x), ArmEmpty</math> } add  { <math>Holding(x)</math> }</pre>
$PutDown(x)$	<pre>pre  { <math>Holding(x)</math> } del  { <math>Holding(x)</math> } add  { <math>ArmEmpty, OnTable(x)</math> }</pre>

Q3. The initial configuration of the environment is given below:

$$I_0 = \{Clear(A), On(A, B), OnTable(B), OnTable(C), Clear(C), Holding(D)\}.$$

Through a sequence of actions/operations, is it possible to achieve the following goal configuration of the environment:

$$g_0 = \{Clear(A), On(B, C), OnTable(A), OnTable(C), OnTable(D), Clear(B), Clear(D), ArmEmpty\}?$$

If you think that it is possible, then show it with a sequence of actions/operations. Otherwise, give a counterexample.

Ans:

Yes, it is possible. For example,

$$\{PutDown(D) \rightarrow UnStack(A, B) \rightarrow PutDown(A) \rightarrow PickUp(B) \rightarrow Stack(B, C)\}.$$

Q4. Start with the initial configuration  $I_0$ . State whether the following sequence of actions/operations can be potentially executed:

$$Stack(D, A) \rightarrow UnStack(D, A)$$

**Ans:**

No, it cannot be executed. The configuration after executing  $Stack(D, A)$  is:

$$I'_0 = \{ArmEmpty, On(D, A), On(A, B), OnTable(B), OnTable(C), Clear(C)\}$$

$Clear(D)$  must be true, but not reflected in  $I'_0$ .

The precondition for  $UnStack(D, A)$  is not satisfied, because  $Clear(D)$  is not in  $I'_0$ . Hence, the operation  $UnStack(D, A)$  cannot be done.

注意：在之前的说明中，stack(D, A) 操作后，并没有关于 Clear(D) 的新状态  
因此，UnStack(D, A) 的前置状态并不满足