

Week 10&11

Exercises

Planning

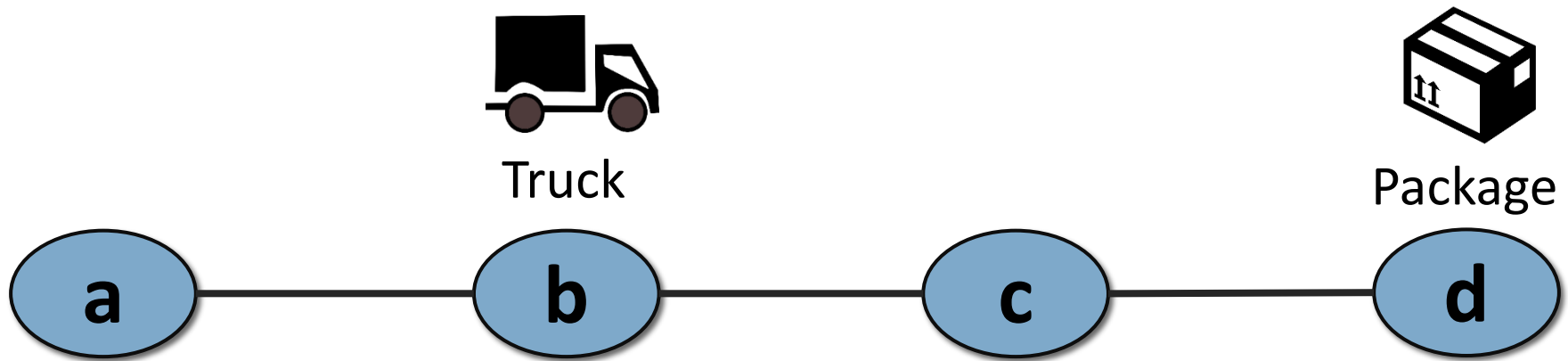
PROF. LIM KWAN HUI

50.021 Artificial Intelligence

The following notes are compiled from various sources such as textbooks, lecture materials, Web resources and are shared for academic purposes only, intended for use by students registered for a specific course. In the interest of brevity, every source is not cited. The compiler of these notes gratefully acknowledges all such sources.

Planning Formulation

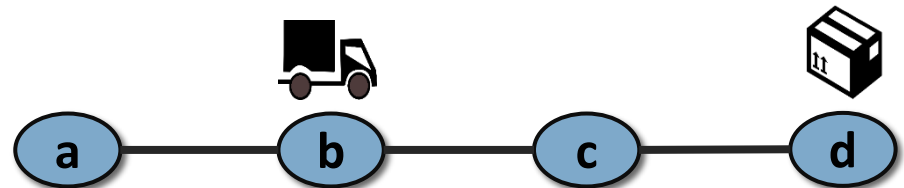
- Consider the below planning problem. There are three locations a, b, c and d, with a truck at b and package at d. The truck is able perform the following actions: (i) $\text{move}(x,y)$: move from location x to y; (ii) $\text{load}(x)$: load a package at location x; and (iii) $\text{unload}(x)$: unload the package at location x.



Planning Formulation

Given the start state in the above diagram, your goal is to get the package to location a. Formulate this planning problem using the STRIPS representation and answer the following:

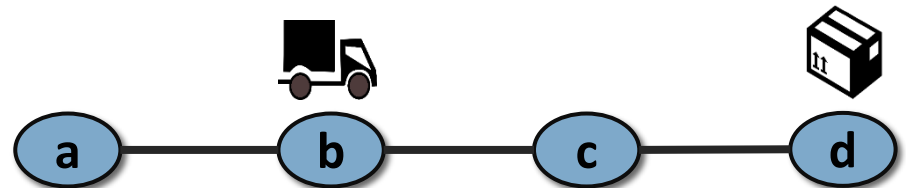
- List down the propositional variables (facts).
- Specify the operators (actions), including the pre-conditions and post-conditions.
- Specify the initial state and the goal state/specification.



Planning Formulation

Given the start state in the above diagram, your goal is to get the package to location a. Formulate this planning problem using the STRIPS representation and answer the following:

- List down the propositional variables (facts).
 - Facts: $\text{truckAt}(x)$, $\text{packAt}(x)$, packInTruck



Planning Formulation

Given the start state in the above diagram, your goal is to get the package to location a. Formulate this planning problem using the STRIPS representation and answer the following:

- Specify the operators (actions), including the pre-conditions and post-conditions.

(:action move(x,y)

:preconditions truckAt(x)

:postconditions not truckAt(x), truckAt(y)

)

(:action load(x)

:preconditions truckAt(x), packAt(x)

:postconditions not packAt(x), packInTruck

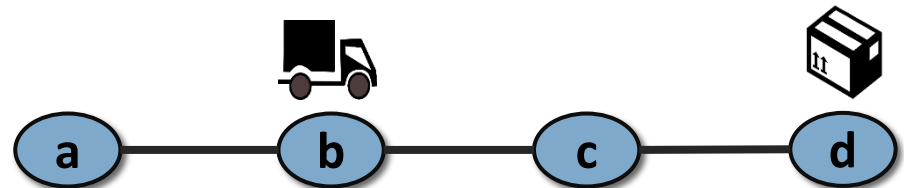
)

(:action unload(x)

:preconditions truckAt(x), packInTruck

:postconditions packAt(x), not packInTruck

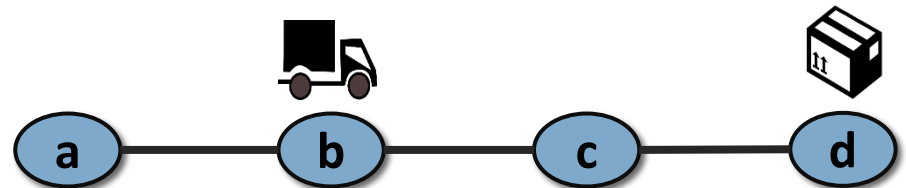
)



Planning Formulation

Given the start state in the above diagram, your goal is to get the package to location a. Formulate this planning problem using the STRIPS representation and answer the following:

- Specify the initial state and the goal state/specification.
 - Initial State: `truckAt(b)`, `packAt(d)`
 - Goal State: `packAt(a)`



Planning Heuristics

- Given this problem definition:
 - Variables: x_1, x_2, x_3, x_4, x_5
 - Initial State: x_1
 - Goal: x_2, x_5
 - Actions:

o_1 :	precond: x_1 ,	postcond: x_2
o_2 :	precond: x_2 ,	postcond: $\neg x_2, x_3$
o_3 :	precond: x_2, x_3 ,	postcond: $\neg x_2, x_4$
o_4 :	precond: x_4 ,	postcond: x_5
- ***Task: Compute the value of h_{add} . Show your workings.***
- ***Task: Compute the value of h_{max} . Show your workings.***

Planning Heuristics

- Concise representation using facts (F) and actions (A)

- $F_0 = x_1$
- $A_0 = o_1,$
- $F_1 = x_1, x_2$
- $A_1 = o_2$
- $F_2 = x_1, x_2, x_3$
- $A_2 = o_3$
- $F_3 = x_1, x_2, x_3, x_4$
- $A_3 = o_4$
- $F_4 = x_1, x_2, x_3, x_4, x_5$

Variables: x_1, x_2, x_3, x_4, x_5

Initial : x_1

Goal: x_2, x_5

Actions: o_1 : pre: x_1 , post: x_2
 o_2 : pre: x_2 , post: $\neg x_2, x_3$
 o_3 : pre: x_2, x_3 , post: $\neg x_2, x_4$
 o_4 : pre: x_4 , post: x_5

Planning Heuristics

- Concise representation using facts (F) and actions (A)

- $F_0 = x_1$
- $A_0 = o_1,$
- $F_1 = x_1, x_2$
- $A_1 = o_2$
- $F_2 = x_1, x_2, x_3$
- $A_2 = o_3$
- $F_3 = x_1, x_2, x_3, x_4$
- $A_3 = o_4$
- $F_4 = x_1, x_2, x_3, x_4, x_5$

Variables: x_1, x_2, x_3, x_4, x_5

Initial : x_1

Goal: x_2, x_5

Actions: o_1 : pre: x_1 , post: x_2
 o_2 : pre: x_2 , post: $\neg x_2, x_3$
 o_3 : pre: x_2, x_3 , post: $\neg x_2, x_4$
 o_4 : pre: x_4 , post: x_5

Task: Compute the value of h_{add}

- $h_{add} = 1 + 4 = 5$

Planning Heuristics

- Concise representation using facts (F) and actions (A)

- $F_0 = x_1$
- $A_0 = o_1,$
- $F_1 = x_1, x_2$
- $A_1 = o_2$
- $F_2 = x_1, x_2, x_3$
- $A_2 = o_3$
- $F_3 = x_1, x_2, x_3, x_4$
- $A_3 = o_4$
- $F_4 = x_1, x_2, x_3, x_4, x_5$

Variables: x_1, x_2, x_3, x_4, x_5

Initial : x_1

Goal: x_2, x_5

Actions: o_1 : pre: x_1 , post: x_2
 o_2 : pre: x_2 , post: $\neg x_2, x_3$
 o_3 : pre: x_2, x_3 , post: $\neg x_2, x_4$
 o_4 : pre: x_4 , post: x_5

Task: Compute the value of h_{max}

- $h_{max} = \max(1, 4) = 4$