# 50.021 – Artificial Intelligence

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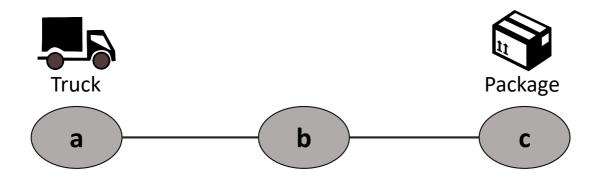
#### Week 11 Theory Homework - Planning

[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. ]

Due: 15th Apr 2024, 11:59pm Submission: via eDimension

#### 1 Logistic Problem I

Consider the following logistic problem. There are three locations a, b and c, with a truck at a and package at c. The truck is able perform the following actions: (i) move(x,y): move from location x to y; (ii) load(x): load a package at location x; and (iii) load(x): unload the package at location x. The truck can only move between adjacent locations, e.g., a to b, b to c (You can assume that these static facts are already modelled/defined).



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

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

#### 2 Logistic Problem II

Based on your STRIPS formulation from Q1 (Logistic Problem I), answer the following:

- a.) What is the optimal solution to this problem?
- b.) Make this a delete-relaxed problem. What are the changes to the original STRIPS formulation you made?
- c.) Based on this delete-related problem, list down all the facts  $F_x$  and actions  $A_x$  at levels  $x = \{0, 1, ..., M\}$ .

### 3 Logistic Problem III

Based on your answer from Q2 (Logistic Problem II), answer the following:

- a.) What is the optimal solution to this delete-relaxed problem? What is this heuristic called?
- b.) What is the value of  $h_{add}$ ? Explain why.
- c.) What is the value of  $h_{max}$ ? Explain why.

### 4 Generic Planning I

Consider a STRIPS problem with propositional variables (facts) m, n, o, p, and the below STRIPS actions with their pre/post-conditions.

Action	Pre	Add	Del
A	m	n,o	Ø
В	m,o	p	m
$\mathbf{C}$	p	m	p
D	n,o	p	О

Given an initial state  $s = \{m\}$  and goal specification  $g = \{m, n, o, p\}$ , answer the following questions:

- a.) What is the value of  $h_+$ ? Explain why.
- b.) What is the value of  $h_{add}$ ? Explain why.
- c.) What is the value of  $h_{max}$ ? Explain why

## 5 Generic Planning II

Based on the same STRIPS formulation in Q4 (Generic Planning I). Now, based on initial state  $s = \{p\}$  and goal specification  $g = \{m, n, o, p\}$ , answer the following questions:

- a.) What is the value of  $h_+$  (if any)? Explain why.
- b.) What is the value of  $h_{add}$  (if any)? Explain why.
- c.) What is the value of  $h_{max}$  (if any)? Explain why.