50.021 – Artificial Intelligence

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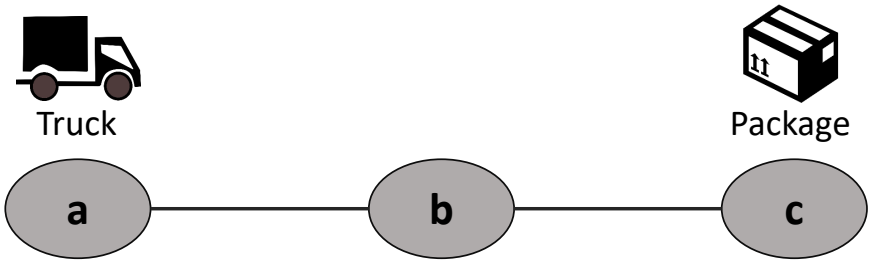
Week 11 Theory Homework - Planning

[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) unload(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	$\emptyset$
B	m,o	p	m
C	p	m	p
D	n,o	p	o

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.