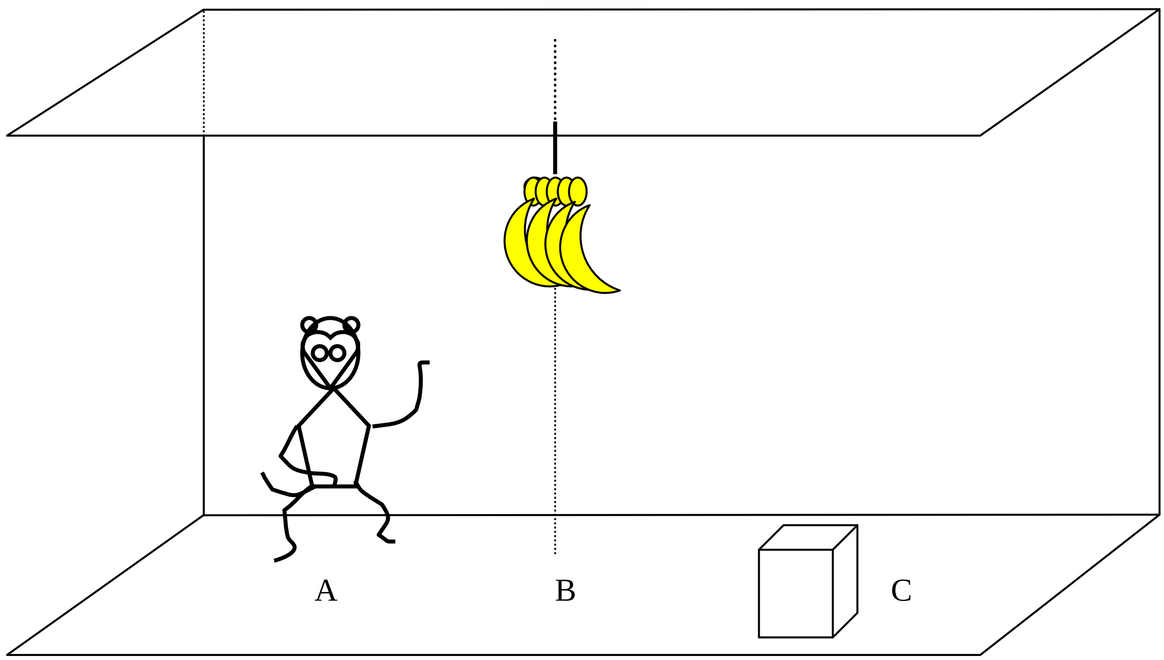
CSCI561 – Introduction to Artificial Intelligence
Instructor: Dr. K. Narayanaswamy
Assignment 5
Due: 11/21/2011 11:59:59pm

Electronic Submission (on Blackboard)

Question1. STRIPS [30 points]

A monkey is in a lab. The monkey wants some bananas. There are three locations in the lab – locations A, B and C. The monkey is at location A. There is a box in location C. There are some bananas in location B, but they are hanging from the ceiling. The monkey needs the box to get to the bananas.



We use the following predicate forms:

- Level (l), in which l=high only if the monkey is on the box, otherwise l=low.
- At (o, x), where o is one of the objects, monkey, box or banana, and x is one of the locations, A, B, or C.
- Have (Bananas).

The monkey has five actions:

- Move (x, y), where x is the initial place (one of A, B or C) and y is the destination place (one of A, B or C). To move, the monkey must not on the box.
- MoveBox (x, y), where x is the initial place (one of A, B or C) and y is the destination place (one of A, B or C). The monkey must not on the box. The effect of this action is that the box is moved from x to y.

- ClimbUp (x), where x one of the locations, A, B or C. The monkey and the box must be both at location x. The effect of this action is that the monkey is on the top of the box, so the level of the monkey is high.
- ClimbDown (x), where x one of the locations, A, B or C. The monkey and the box must be both at location x, and the monkey must be on the top of the box. The effect of this action is that the level of the monkey is low.
- TakeBananas (x), where x one of the locations, A, B or C. To get the bananas, the monkey, the box and the bananas must be all at location x, and the monkey must be on the top of the box.

We want to set up this problem so that a STRIPS-type problem solver can produce a plan to get the robot to the mountain.

1. What is the initial state description and the goal?
2. What are the operators and their descriptions (preconditions, delete list, add list) needed to solve this problem?
3. Give a solution plan to the preceding problem that a STRIPS system (working forward from initial state to goal) might produce. Write your solution in the following format:

    Literals in the initial state, S0
    First Operator
    Literals in the subsequent state, S1
    Second Operator
    etc. until a state satisfying the goal is reached.

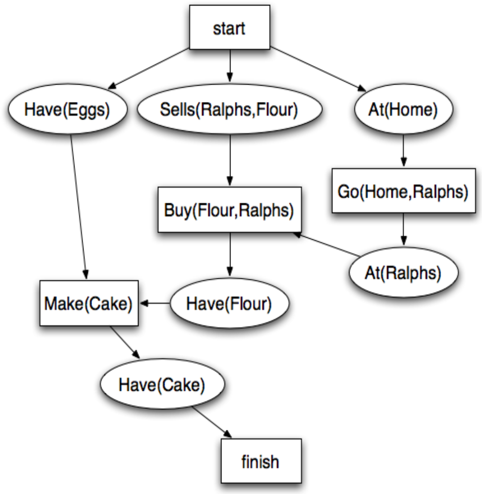
Question2. [20 points]

Consider using a partial-order planning system for making a cake. Assume that in this domain there exist the following three STRIPS operators:

Operator	Preconditions	Add list	Delete list
Go(a, b)	At(a)	At(b)	At(a)
Buy(o, s)	At(s) Sells(s, o)	Have(o)	
Make(Cake) Have(Eggs) Have(Flour)	At(Home)	Have(Cake) Have(Flour)	Have(Eggs)

Our initial state is: At(Home), Have(Eggs), Sells(Ralphs, Flour)
Our goal state is: Have(Cake)

Suppose we start with the partial plan shown in the following figure. The partial plan currently contains no ordering constraints other than those implied by the partial order of the partial plan.



Describe the threats to any of the causal links shown in this partial plan, if any. Show how you would resolve the conflicts in each case. If you see no threats to causal links, justify your answer in terms of each causal link.

Question3 [20 points]
Given the following joint probability table

	Toothache		¬Toothache	
	Catch	¬ Catch	Catch	¬ Catch
Cavity	0.108	0.012	0.072	0.008
¬ Cavity	0.016	0.064	0.144	0.576

1. What is the probability of Toothache, namely P(Toothache)?

2. What is the probability of Toothache and Catch, namely P(Toothache, Catch)?

3. What is the probability of Cavity given Catch, namely P(Cavity|Catch)?

Question4:- Probabilistic Reasoning [30 points]

In your local nuclear power station, there is an alarm that senses when a temperature gauge exceeds a given threshold. The gauge measures the core temperature. Consider the Boolean variables A (alarm sounds), FA (alarm is faulty), and FC (gauge is faulty), and the multi-valued nodes G (gauge reading) and T (actual core temperature).

a. Draw a belief network (Bayesian Network or probabilistic network) for this domain, given that the gauge is more likely to fail when the core temperature gets too high.

b. Is your network a polytree?
(A polytree is a singly connected network. In such networks, there is at most one undirected path between any two nodes in the network. Polytrees play an important role in uncertainty reasoning by making it easier to support backward chaining, for example.)

c. Suppose there are just two possible actual and measured temperatures, Normal and High; And that the gauge gives the incorrect temperature x% of the time when it is working, but v% of the time when it is faulty. Give the conditional probability table associated with G.

d. Suppose the alarm works unless it is faulty, in which case it never goes off. Give the conditional probability table associated with A.

e. Suppose the alarm and gauge are working, and the alarm sounds. Calculate the probability that the core temperature is too high.

f. In a given time period, the probability that the temperature exceeds threshold is p. The cost of shutting down the reactor is C_S; the cost of not shutting it down when the temperature is in fact too high is C_M (m is for meltdown). Assuming the gauge and alarm to be working normally, calculate the maximum value for x for which the gauge is of any use (i.e., if x is any higher than this, we have to shut down the reactor all the time).

g. Suppose we add a second temperature gauge H, connected so that the alarm goes off when either gauge reads High. Where do H and F_H (the event of H failing) go in the network?

h. Are there circumstances under which adding a second gauge would mean that we would need more accurate (i.e., more likely to give the correct temperature) gauges? Why (not)?

Submission: - You must create a pdf document for this assignment. Name your pdf file as follows: - firstname_lastname_A5.pdf. For example John_Smith_A5.pdf would be a correct file name. To submit your assignment, simply select the appropriate assignment link from the Assignments subsection of the course blackboard website. Upload your pdf file and click submit.

Errors in submission will be assessed –25 points. Only your FINAL submission will be graded.

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