CPSC 322 **Artificial Intelligence I** **November 2020**

Practice Midterm #2

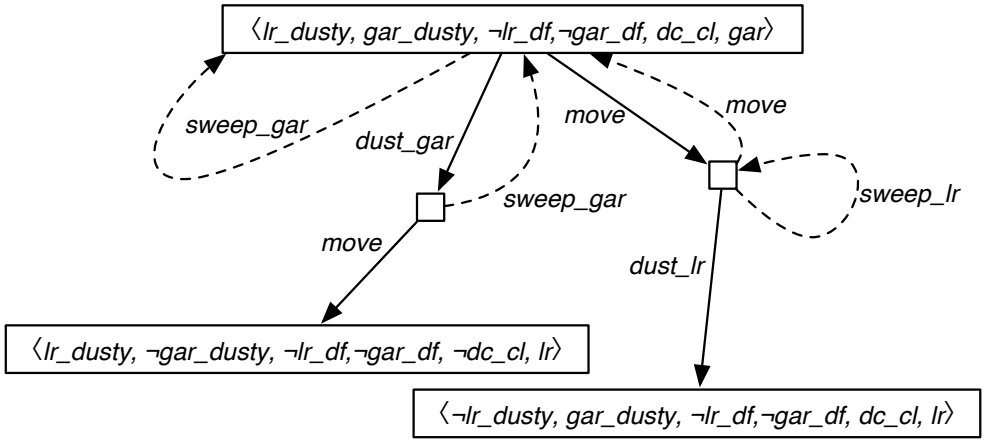
Solution

Question 1

Solution

(a) Preconditions: $[Rob\_loc = garage,\ Dustcloth\_clean = true,\ Gar\_dusty = true]$
Effects: $[Gar\_dusty = false, Dustcloth\_clean = false]$

(b) See:

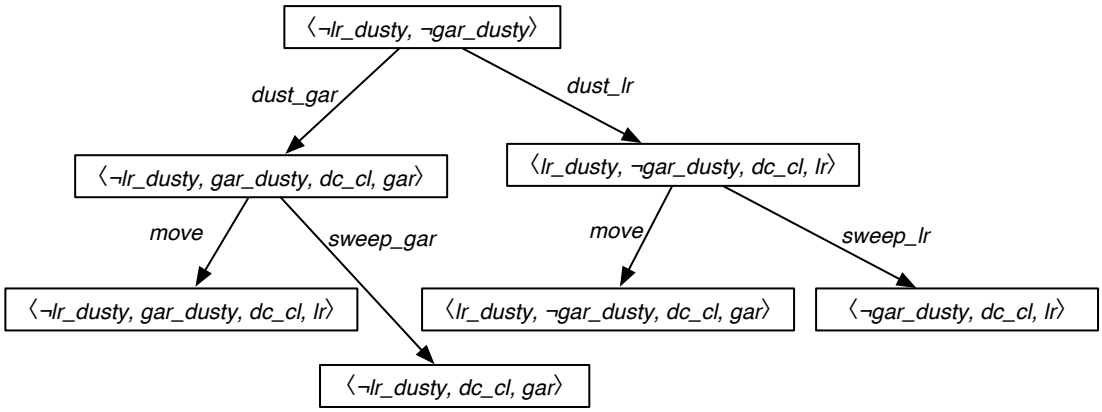


Note that you are not expected to give the initial states or the intermediate states.

In this diagram the dashed lines are the actions that would be pruned with multiple-path pruning or loop detection. In the exam we will make it explicit as to whether these are shown as being arcs (if there wasn't MPP or loop detection), shown as being pruned, or not shown.

(c) See two of the leaves of the previous diagram.

(d) See:



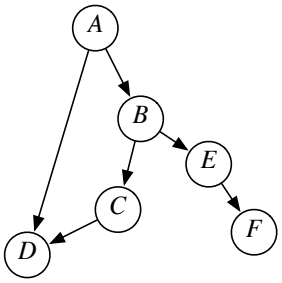
Note that you are not expected to give the initial or the intermediate state.

(e) See two of the leaves of the previous diagram.

Question 2

Solution

(a) The belief network is:



(b) E and F can be pruned.

(c) You will have a factor on B, C and D:

B	C	D	Value
true	true	true	0.8*0.9*0.5+(1-0.8)*0.3*0.7
true	true	false	0.8*0.9*(1-0.5)+(1-0.8)*0.3*(1-0.7)
true	false	true	0.8*0.9*0.6+(1-0.8)*0.3*0.2
...	...	...	...

This is the result of $\sum_A P(A) * P(B \mid A) * P(D \mid A, C)$

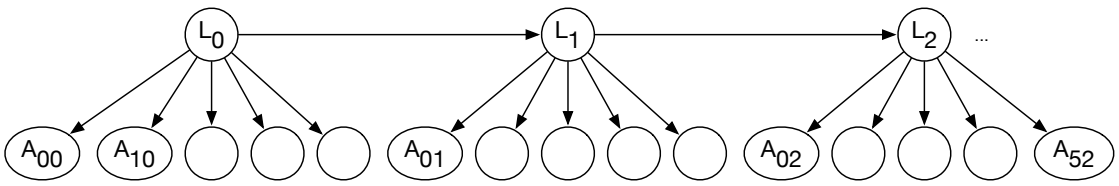
(d) Call the previous factor f_1. After prining E and F and eliminating A, we need to eliminate B and C:

Variable Eliminated	Factors Removed	Factor Added
B	$f_1(B, C, D), P(C \mid B)$	$f_2(C, D)$
C	$f_2(C, D)$	$f_3(D)$

Question 3

Solution

(a) Let the location at time i be L_i, and suppose the value of sensor j at time i is A_{ji}:



Sam needs to specify $P(L_0)$, $P(L_{i+1} \mid L_i)$ and $P(A_{ji} \mid L_i)$ for each sensor j.

(b) Each location is independent of the previous locations and previous sensor readings given the immediately previous locations. L_{i+1} is independent of all previous locations and previous sensor readings given L_i (where "previous" means at time i or earlier). Each sensor reading is independent of each other location and sensor reading given the robot's current location. (A_{ji} is independent of every other variable given L_i).

(c) The only assumption we made is the independence assumption, so it much be that the independence assumption is not appropriate. The sensors might be dependent given the same location.

(d) Sam could better model the dependence between the sensors, by either adding arcs between the sensors readings, or adding extra nodes that represent why the sensors are dependent. (Remember that we did something simular in Assignment 6, question 2(c).)

(e) If Sam manipulated one of the sensors (e.g., by breaking it) it would have no effect on the other variables, but if we had observed the sensor value, it can change the probability of all other variables. If Sam manipulated L_i (e.g., by actually picking up and moving the robot) it would affect all subsequent variables (including the sensor variables at time i and all variables at later times), but not the variables before time i. If Sam observed the location, it would change the probability of all other variables.