Machine Data & Learning

Assignment-5 PartB

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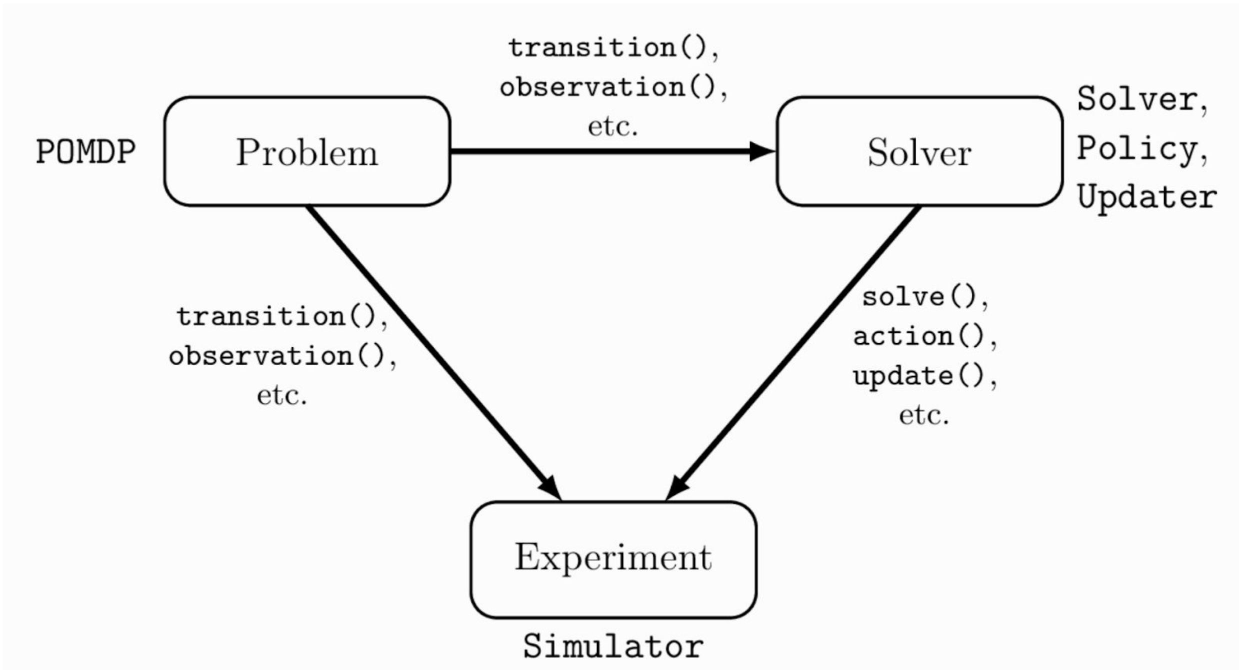

THEORETICAL ANALYSIS

A **partially observable Markov decision process** (POMDP) is a generalization of a **Markov decision process** (MDP). A POMDP models an agent decision process in which it is assumed that the system dynamics are determined by an MDP, but the agent cannot directly observe the underlying state. Instead, it must maintain a probability distribution over the set of possible states, based on a set of observations and observation probabilities, and the underlying MDP.

Now → Total Possible States=[9*9*2]=162

The Grid is 3x3 matrix where we assume that (i,j) {i and j are zero indexed} represents the cell number with i rows above it and j columns to its left.

(0,2)	(1,2)	(2,2)
(0,1)	(1,1)	(2,1)
(0,0)	(1,0)	(2,0)

This represents the markings in the grid.

Solutions

Roll Number-2018114007

x= (1- (8/100)) =**0.92**

Reward for Target State ⇒ 17

Question-1

Given

- Observation O6 (target is not in the 1 cell neighbourhood of the agent)
- Target ⇒ (1,1)

Solution

Now according to the condition, The target is not in the 1 cell neighbourhood of the agent.

Number of 1st neighbours of 1,1 ⇒ {(0,1),(1,0),(1,2),(2,1)}

So now the number of left squares are ⇒ 4

Since the condition of on and off doesn't really matter so total number of cases ⇒ 4*2(2 for on and off) =8

Now the agent can be any of the states with any of the configuration , so probability of them is ⅛ = 0.125

So for the states ⇒ [(0,4,0) , (0,4,1) , (6,4,0) , (6,4,1) , (2,4,0) , (2,4,1) , (8,4,0) , (8,4,1)] value of initial belief is 0.125 and for others is zero.

Question-2

Given

- Initial place state⇒ (0,1)
- Target in one neighbour
- Call set to false

Solution

The general tuple for such a state for a is given by:

s = ((0, 1), target_pos, False)

Here, target_pos is one of (0, 1), (0, 0), (0, 2) or (1, 1) since it is in the 1-neighbourhood

of (0, 1).There are hence 4 states that fit the given general form. In the initial belief state, the belief value for each of these 4 states{(3,0,0) , (3,3,0) , (3,6,0) , (3,4,0)} is ¼ and the belief value for the rest is 0.

Question-3

Part1

Expected utility for Initial state 1

#Simulations	Exp Total Reward	95% Confidence Interval
1000	1.8659	(1.73931,1.99249)

Part 2

Expected utility for Initial state 2

#Simulations	Exp Total Reward	95% Confidence Interval
1000	5.46905	(5.34289,5.59522)

Question-4

Case 1

In the first case the where agent is in (0, 1) and the target is in the four corners of the cell, we have the Table as :

	0	1	2
0	Target	Agent	Target
1			
2	Target		Target

This gives the observations o2 and o4 with probability ¼ each and the observation o6 when agent is in (0, 1).

Case 2

When agent's is in the (2,1) position .

	0	1	2
0	Target		Target
1			
2	Target	Agent	Target

This also gives the observations o2 and o4 with probability ¼ each and the observation o6 with probability ½ when agent is in (2, 1).

Now Calculate observations probability (As we have the same observations from both states, there is no need to weight the observation probabilities with the probability of the occurrence of the agent's positions.)

P(o1)= 0

P(o2)=0

P(o3)=0.6*0.25+0.4*25=0.25

P(o4)=0

P(o5)=0.6*0.25+0.4*25=0.25

P(o6)=0.6*0.5+0.4*0.5=0.5

Hence the observation we are going to most likely observe is o6.

Question-5

The formula for calculating the number of trees in **POMDP is** $|A|^N$

where N = Number of nodes in the tree and A = All possible actions

Formula to calculate N:

N = $\frac{|O|^{T-1}-1}{|O|-1}$

where T = Levels in the tree and O = Number of observations

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