Assignment-3 POMDP SOLVER

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Cells and states in POMDP
ROLL NUMBER USED: 2019101116

1,0	1,1	1,2	1,3
0,0	0,1	0,2	0,3

Agent can be in any of the above 8 cells
Target can be in any of the above 8 cells
And the target can either call or not in each cell ie boolean

So the no of states in The POMDP are 8*8*2= 128, each state in POMDP can be represented as a tuple (Agent Position, Target Position, Call)

Observation sensors :
• o1 is observed when the target is in the same cell as the agent.
• o2 is observed when the target is in the cell to the right of the agent's cell.
• o3 is observed when the target is in the cell below the agent's cell.
• o4 is observed when the target is in the cell to the left of the agent's cell.
• o5 is observed when the target is in the cell above the agent's cell.
• o6 is observed when the target is not in the 1 cell neighborhood of the agent.

Q1 :

Given Target is in (1,0) and Observation is that the target is not in the 1cell neighborhood of agent ie only possible cells for Agent are (0,1) ,(0,2) , (0,3) ,(1,2) ,(1,3)
If we calculate no of states are 5 * 1 * 2 = 10 (uniform)

The 10 states and their initial belief states

- ((0,1) , (1,0) , 1) has probability 1/10 = 0.1
- ((0,1) , (1,0) , 0) has probability 1/10 = 0.1
- ((0,2) , (1,0) , 1) has probability 1/10 = 0.1
- ((0,2) , (1,0) , 0) has probability 1/10 = 0.1
- ((0,3) , (1,0) , 1) has probability 1/10 = 0.1
- ((0,3) , (1,0) , 0) has probability 1/10 = 0.1
- ((1,2) , (1,0) , 1) has probability 1/10 = 0.1
- ((1,2) , (1,0) , 0) has probability 1/10 = 0.1
- ((1,3) , (1,0) , 1) has probability 1/10 = 0.1

- ((1,3) , (1,0) , 1) has probability 1/10 = 0.1

The Other belief states are 0

Q2 :

Given Agent is in (1,1) and Target is in one cell neighborhood ie possible cells for the neighborhood are (1,1), (1,0), (0,1), (1,2), and give call is not taken so the no possible states are 1*4*1 = 4.

The 4 states an their initial belief states :

- ((1,1) , (1,1), 0) has probability ¼ = 0.25
- ((1,1) , (1,0), 0) has probability ¼ = 0.25
- ((1,1) , (0,1), 0) has probability ¼ = 0.25
- ((1,1) , (1,2), 0) has probability ¼ = 0.25

Other states will have belief states as 0

Q3:

The expected Value for initial Belief states in 1 is 23.6745
The expected Value for initial Belief states in 2 is 37.8091
These values can be found by executing pomdpsim by specifying no of simulations, above results are for simulation len = 100, no of simulations = 100

Q4:

- The Agent is in (0,0)
    - This happens with Probability = 0.4
        - The Target is in (0,1)
            - The observation is o2
            - This probability of o2, in this case, is = 0.25 * 0.4
        - The Target is in (0,2)
            - The observation is o6
            - This probability of o6, in this case, is = 0.25 * 0.4
        - The Target is in (1,1)
            - The observation is o6
            - This probability of o6, in this case, is = 0.25 * 0.4
        - The Target is in (1,2)
            - The observation is o6
            - This probability of o6, in this case, is = 0.25 * 0.4
- The Agent is in (1,3)
    - This happens with Probability = 0.6

- The Target is in (0,1)
  - The observation is o6
  - This probability of o6, in this case, is = 0.25 * 0.6
- The Target is in (0,2)
  - The observation is o6
  - This probability of o6, in this case, is = 0.25 * 0.6
- The Target is in (1,1)
  - The observation is o6
  - This probability of o6, in this case, is = 0.25 * 0.6
- The Target is in (1,2)
  - The observation is o4
  - This probability of o4, in this case, is = 0.25 * 0.6

P(observing o2) = 0.25 * 0.4 = 0.1
P(observing o6) = 3* 0.25*(0.4 + 0.6) = 0.75
P(observing o4) = 0.25 * 0.6 = 0.15

O6 is most likely to expect because of its high probability of occurrence

Q5:

The formula for the number of Policy Trees

How many policy trees, if |A| actions, |O| observations, T horizon:

- How many nodes in a tree:

$$N = \sum_{i=0}^{T-1} |O|^i = (|O|^T - 1) / (|O| - 1)$$

How many trees:

$$|A|^N$$

#Trial
216

#Trail is used as T in the question , For us T = 216

Number of Nodes = $6^{216} - 1 / 5$

Number of Trees = $|A|^N = 5^{(6^{216}-1)/5}$