Assignment 5 - Part 2

Due Date : 27th April, 11:55 am(Noon)

Instructions:

- You will need to install SARSOP solver for this assignment, the instructions for the same are given in the link - https://github.com/AdaCompNUS/sarsop.The link also explains various functionalities that are needed for the assignment.
- You can get to know about the solver more over here : http://www.cs.cornell.edu/~rongnan/publications/icra2008_pomdpPlanner.pdf

Problem :

In this assignment you will frame a POMDP for a tracking problem and use SARSOP solver to get the optimal policy. In the tracking problem an agent needs to find out the position of a target. The agent will be rewarded if it is in the same cell of the target when the target makes a call.

The instructions for framing the POMDP are as follows:

1) Agent and target move in a 3x3 grid. Each state of the POMDP is represented as a tuple (Agent Position, Target Position, Call). Here agent position and target position are tuples of position in the grid.

2) At each state we have five possible actions: Stay, Up, Down, Left, Right.

3) The target can move in all directions with equal probability of 0.15 and stay in the same position with a probability of 0.4. It can make a call with a probability of 0.4 and turn off the call with a probability of 0.2.

4) Transition probabilities for the agent are :

- If it wants to stay at the same location then the action is executed perfectly, that is the agent's position doesn't change.
- On the other hand, if it wants to move then it moves in the desired direction with a probability of x and with a probability of 1-x it moves in the opposite direction. Here x = 1 - (((LastThreeDigitsOfRollNumber)%40 + 1) / 100)

5) The agent and target cannot move outside the grid, when they try to move outside the grid , they will stay back in the same state with a probability of x.

6) Sensors on the agent can detect the following 6 observations with 100% accuracy:

- 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 agent's cell
- o4 is observed when the target is in the cell to the left of 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 neighbourhood of the agent.

7) The rewards for the agent will be as follows:-

- -1 for each step that it takes.
- (**<RollNumber>**%100 + 10) for reaching the target before the call is turned off.

Questions :

Now you need to create the appropriate POMDP file as per the instructions and answer the following questions :

1. If you know the target is in (1,1) cell and your observation is o6 , what will be the initial belief state? Please submit the optimal policy file named **<RollNumber>.policy** for the POMDP taking into account the initial belief state you obtained.
2. If you are in (0,1) and you know the target is in your one neighborhood and is not making a call what is your initial belief state?
3. What is the expected utility for initial belief states in questions 1 and 2?
4. If your agent is in (0,1) with probability 0.6 and in (2,1) with probability 0.4 and the target is in the 4 corner cells with equal probability, which observation are you most likely to observe? Explain.
5. How many policy trees are obtained in this case, explain?

Deliverables:

- Report of Part A of the assignment that is **partA-Report.pdf**.
- A text file which has the beliefs as mentioned in part-A that is **<RollNumber>.txt**.
- You need to create a report containing the answers for the questions, please provide all the steps and explanations involved in answering a particular question. Name the report as **partB-Report.pdf** .
- Policy file mentioned in the 1st question, name it as **<RollNumber>.policy.**
- **Put the above four deliverables** in a folder named **<RollNumber>** and submit a compressed file named **<RollNumber>.zip.**
- The directory structure should be as follows:
    - partA-Report.pdf
    - <RollNumber>.txt.
    - partB-Report.pdf
    - <RollNumber>.policy

Submission Instructions :

- Please follow the naming conventions strictly.
- A typed report is strongly recommended. However, if you're submitting a handwritten report, make sure the handwriting is decent enough and the scanned document is of high resolution. Failure of doing so would lead to a straight zero.